POPULAR SCIENCE

MAY JUNE 1931

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NEW INVENTIONS · MECHANICS · MONEY MAKING IDEAS
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...HIS UNCLE'S GUILTY PAST.... by Timmins

YOU KNOW HOW CRAZY I'VE BEEN ABOUT GRACE, UNCLE. SHE SEEMED TO LIKE ME, TOO. THEN SHE CHANGED — SNUBS ME POLITELY NOW. TURNS DOWN MY DATES — AND WON'T GIVE A REASON
REMINDS ME OF SOMETHING THAT HAPPENED WHEN I WAS COURTING YOUR AUNT EMMA
SHE TOOK A TURN OF ACTING SO STIFF AND DISTANT I WAS WORRIED, TOO
LATER YOUR DAD GAVE ME A TIP. SEEMS I'D BEEN GETTING A LITTLE CARELESS ABOUT "B.O."
SAY, ARE YOU HINTING THAT I....?

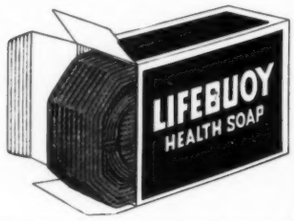
FORTUNATELY, I COULD GET LIFEBUOY EVEN IN THOSE DAYS. I DIDN'T TAKE ANY MORE CHANCES AFTER THAT
ENOUGH SAID, UNCLE! I'M GETTING LIFEBUOY NOW!
"B.O." GONE —
Uncle prepares to say — "BLESS YOU, MY CHILDREN"
LOOKS LIKE I'LL BE HAVING A NEW NIECE SOON. I THOUGHT GRACE WOULD TAKE HIM AFTER LIFEBUOY PUT AN END TO THAT "B.O."

"B.O." (body odor) has ALWAYS been an unforgivable fault!

IN LOVE—in social or business relations—"B.O." (*body odor*) is a handicap *no one* can afford to risk! It's easy to offend unknowingly, for pores give off a *quart* of odor-causing waste daily. Warmer weather makes us perspire even more freely—increases "B.O." danger. Play safe—bathe regularly with Lifebuoy. Its clean, fresh, quickly-vanishing scent tells you Lifebuoy is *different* from ordinary toilet soaps—gives *extra* protection. Its rich, penetrating lather purifies and *deodorizes* pores—stops "B.O."

Dull skins freshen

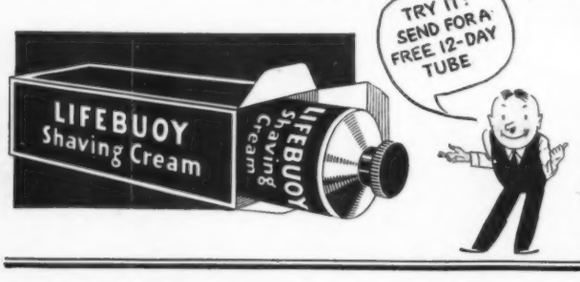
Make Lifebuoy your complexion soap—watch your skin improve! For Lifebuoy *deep-cleanses*—its creamy, searching lather rids pores of clogged impurities—makes dull complexions glow with health.



A PRODUCT OF LEVER BROTHERS CO.

He learned about shaving from her! by J.F. HART

LIFEBUOY SHAVING CREAM, PLEASE. ONLY ITS EXTRA-MOIST LATHER CAN SOFTEN MY TOUGH BEARD
I'LL GET A TUBE FOR ED, DAD. HE CAN'T GET DECENT SHAVES
ED, HERE'S A TUBE OF LIFEBUOY SHAVING CREAM. DAD SAYS IT SOOTHES TENDER SKIN — GIVES CLEAN, CLOSE SHAVES
OH, THANKS. I'LL TRY IT TOMORROW MORNING
KATE, YOUR DAD WAS RIGHT. THIS IS THE SMOOTHEST SHAVE I EVER HAD! AND DOES MY FACE FEEL GREAT! HERE'S ANOTHER VOTE FOR LIFEBUOY
I'M GLAD IT HELPS, ED.



Use this extra-moist lather that soaks beards soft—soothes skin

Holds 52% more moisture

FOR a clean, snappy, long-lasting shave—there's nothing like Lifebuoy Shaving Cream. Because it holds 52% more moisture, Lifebuoy lather does what ordinary thin, quick-drying lathers never can do. It *soaks* stubborn stubble soft—*extra soft.* Tough whiskers come off quicker, cleaner, easier. It's kind to the skin, too—leaves it soft, relaxed, refreshed. Try it. Get the big cheerful red tube at your druggist's. Or write to Lever Bros. Co., Dept. A-146, Cambridge, Mass., for a free trial tube. (*This offer good in U. S. and Canada only.*)

"WHEN you're running about thirty miles an hour these pistons are flying up and down a couple of thousand times a minute. Think about how fast that is and then you see that if they get smacked on the nose every time, sooner or later you run into trouble.

"Most people don't realize just how much damage knocking gasoline can do to a car. That's why I told you that you better use Ethyl Gasoline last time you were in. Remember?

"It's your car and your money — but after we get this job fixed, *take my advice* and use Ethyl. It's cheaper in the long run, and what's more, you'd be surprised to see how much more life it gives to an older car." *The next best thing to a brand-new car is Ethyl in the tank of your present car.* Ethyl Gasoline Corporation, New York City.

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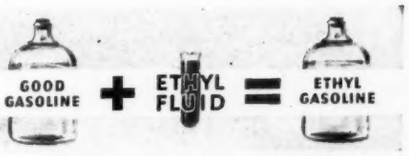

Ethyl fluid contains lead. © E. G. C. 1933

NEXT TIME STOP AT THE ETHYL PUMP

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ARTHUR WAKELING, *Home Workshop Editor*
ALDEN P. ARMAGNAC, *Associate Editor*
SYDNEY OXBERRY, *Art Editor*

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In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

How to SIMONIZ Your Car!

TO REMOVE GRIME, DISCOLORATIONS AND DULLNESS ALWAYS USE THE WONDERFUL SIMONIZ KLEENER. Nothing could be swifter or safer! No hard rubbing! Just a few easy strokes restores the lustre to the finish and makes your car look new again.

TO KEEP YOUR CAR BEAUTIFUL FOR YEARS PROTECT THE FINISH WITH SIMONIZ. Made to withstand all conditions of weather and climate! Lasting! Simply applied with a cloth! Simoniz keeps injurious elements from getting at the finish to dull and destroy it. Protects the finish, positively makes it last longer and keeps the colors from fading.

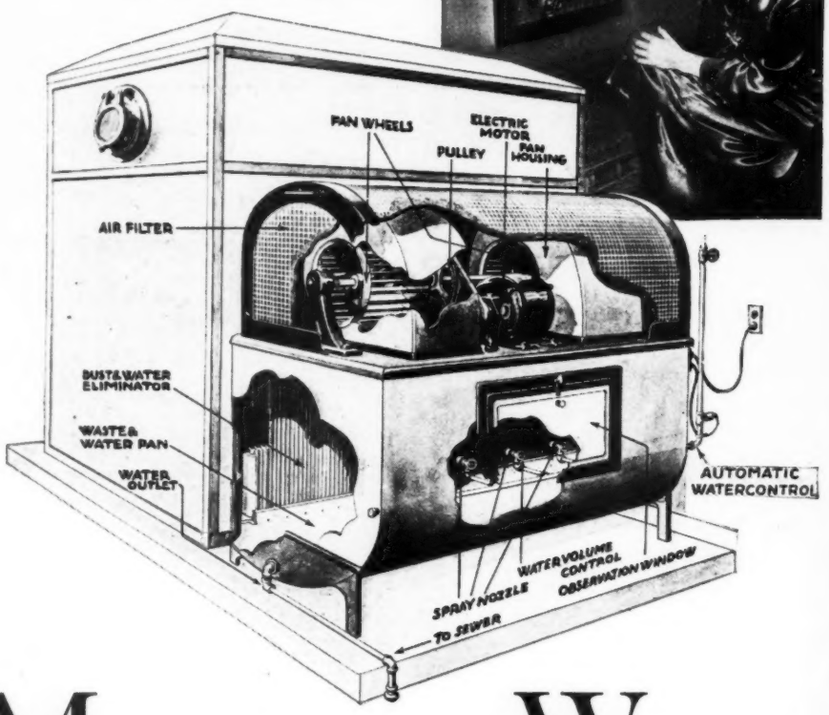
ALWAYS BEAUTIFUL WITHOUT BOTHER OR EXPENSE. Dust and dirt wipe off easily from the Simonized finish with a dry cloth. Washing is rarely, if ever, necessary. Think, in a few seconds you can always have a car that sparkles like new. So Simoniz your car, and do it right away, too!

Always insist on Simoniz and Simoniz Kleener! Sold at hardware and auto accessory stores everywhere.

MOTORISTS WISE • SIMONIZ

By R. M. BOLEN
Secretary Popular Science Institute

In the weather maker, right, air is passed through a copper mesh filter and then mixed with a fine whirling water spray. Dust and impurities are thus removed and moisture added to the air. Below, drawing shows details of an air-conditioner which is attached to the rear of a warm air heater



Manufactured Weather
FOR THE HOME

WHEN he built his first fire, primitive man made the world's first air conditioner. The warmth of its bright yellow glow provided comfort from the chilling evening winds.

Today, air conditioning is a far broader term. It means more than merely heating the air when it is cold. Science has found that other factors are essential to comfort in summer as well as winter. Air must be cooled if it is hot, dried if it is too wet, wetted if it is too dry, cleaned if it is dirty, and circulated to insure even temperature.

The importance of each of these items, of course, depends on conditions. There is little need for heating in the sultry tropics. Cooling, on the other hand, is useless in the cold climates of the north. Likewise, cleaning, while essential in the dusty cities, is of little value in the country.

Modern methods of air conditioning are elastic processes. They can be altered to meet requirements and carefully designed and tested equipment is available for every need of the home or factory.

Years ago, Mark Twain said, "Although everybody talks about the weather, nobody does anything about it." But Mark Twain was born fifty years too soon. Today, air conditioning equipment can supply manufactured weather to the home as well as the motion picture palace and the industrial plant.

In the modern sense, air conditioning consists of four important processes—temperature control, humidity control, circulation, and cleaning. Each factor adds to the air in homes and public buildings qualities that are important to health and comfort.

Air heated artificially loses moisture. This moisture must be supplied to create the proper balance. In summer, the air contains too much moisture. This must be removed for comfort's sake. Air conditioners solve both of these problems automatically, and circulate, temper, and filter the air as well.

To the owner of a home equipped with a warm air furnace, science offers all sorts of air con- *(Continued on page 5)*

MANUFACTUREDWEATHER FOR THE HOME

(Continued from page 4)

ditioning devices. Some do a complete job, others merely supply one or two of the four air conditioning requisites. Individual blowers, automatic humidifiers, and air filters can be attached easily to existing warm air furnaces, or a complete system that washes, tempers, wets or dries, and circulates the air can be installed to feed conditioned air to the furnace and air ducts.

With some complete auxiliary systems, cooling is obtained from ordinary city water. In localities where the city water is not cold enough or where the summer temperatures are excessive, certain manufacturers have available mechanical refrigerating units that cool the air the desired temperature.

The home heated by steam, vapor, or hot water also can be equipped with air conditioning equipment. As with the warm air systems, the apparatus can be either supplementary or central, complete or partial.

Complete ventilating units can be installed in the windows of any home regardless of the type of heating system in use. Units, no larger than a small radio, can be attached to the window sills to filter and circulate the outside air into the room.

Automatic auxiliary humidifiers for winter use range from attractively designed table urns to radiators that provide just the right amount of moisture for any temperature.

Portable room coolers, that chill the air by passing it over a cake of ice, offer an air conditioning unit for summer use that can be wheeled from room to room as required.

But, the home owner asks, how much does air conditioning equipment cost? How do I know that the condition of my house warrants the investment? Like heating systems, the cost of air conditioning equipment varies depending on conditions, the degree of air conditioning desired, locality, and installation. Complete costs vary from a few dollars for a humidifier to be connected to an existing warm air furnace to thousands for a large central plant installation.

For the home owner interested in the possibilities of air conditioning, Popular Science Institute has compiled a ten page bulletin listing the various types of air conditioning equipment available for the home. This will be mailed free to every reader who sends six cents in stamps to cover the mailing charges. In order that all the necessary information may be sent you, please state the size of your house, type of heating system in use and fuel employed, extent to which the house is insulated, and specify what degree of air conditioning you desire.

Now Ready

Two valuable bulletins have been prepared for the readers of POPULAR SCIENCE MONTHLY One is a new twenty-four-page specification list of the new 1933 radio sets compiled by the Popular Science Institute. It contains full information regarding tubes, prices, wave-lengths, and features. The other, a bulletin on air conditioning, outlines the type of air conditioning equipment now available to the home owner. There is no charge for these bulletins except postage. To cover mailing send 15 cents for the radio bulletin and 6 cents for the air conditioning bulletin. Both bulletins will be mailed to you upon the receipt of 21 cents.

Get Set FOR ANOTHER 10,000 MILES WITH CHAMPION EXTRA RANGE SPARK PLUGS

"Champion National Change Week is your reminder to get set for another 10,000 miles. Just look at these plugs of yours in this Tester as compared to Champion Extra Range Spark Plugs • See how your old plugs flicker and stop sparking. That weak spark means wasted gasoline. That's why it pays to change spark plugs every 10,000 miles. It also insures better performance • Now see how this new Champion stands the gaff. Some difference, eh? • See that peculiarly shaped insulator? It's patented and is the reason why Champions have the widest driving range known. It means extra power, extra speed and absolute dependability. You ought to have a set of these new Champions, even if you hadn't gone over 10,000 miles. Okay, it won't take me five minutes to install a set" • Champion Spark Plug Company, Toledo, Ohio; Windsor, Ontario.

CHAMPION
EXTRA-RANGE
SPARK PLUGS

This patented shape means Champion EXTRA RANGE performance. Look for it

National Change Week
May 7 to 14

Our Readers Say

The Fish Just Grow and Grow But Where Do They Come From?

IN 1930 my son-in-law, at my request, built a pond in his pasture in the rice district of this state, and stocked it with minnows taken during March from a large rice canal. Just before Christmas, he drained the pond to see how his fish were getting along. To his great surprise, he found he had about 500 big mouth trout from eight to fourteen inches long and about half a wagonload of drumfish the size of his hand. Spurred by this success, he built a second pond for canal minnows and a third for gold fish which he raises and sells for bait. This experience convinces me that any one can have plenty of fish for his own use if he will follow my son-in-law's example. One thing I do not understand is how the millions of fish that grow every year in the rice canals get there. The water in these canals is pumped in from wells but when the canals are drained the ditches are lined with the little fish. Where do they come from?—M. S. B., Shreveport, La.

Here's One Who Wants His Chemistry in Chunks

I SPEAK for both myself and my friends when I say that your magazine is the best science magazine published, but we would like to see more and more chemistry. Several people I know have started chemical laboratories because of the interest stimulated by your chemistry articles. Don't let Mr. Hall stop his articles on the microscope. Every one of his pieces carries valuable information.—G. A., Murray, Ia.

Your Hydrogen Atoms Were Left Undisturbed

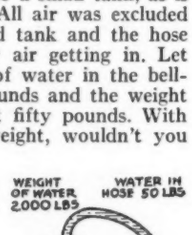
IN REPLY to the question of S. B. M., of Des Moines, Ia., as to what happened to his two parts of hydrogen, I want to say that nothing happened to them because nothing was done to separate the oxygen atoms from the hydrogen atoms in the water. The iron nail in the process of oxidation combined with the oxygen that was dissolved in the water and not the oxygen that constitutes the water. Therefore, no hydrogen atoms were released. The oxygen that makes up the water is not utilized because iron does not decompose water at ordinary temperatures. The only substances that will decompose water at ordinary temperatures are sodium, potassium and calcium upon the application of heat. If the nail were placed in distilled water, oxidation would not take place because the oxygen was driven off by distillation.—L. D., Brooklyn, N. Y.

What's 30,000,000 Years to an Innocent Gallfly?

ANSWERING the "mean little question" asked by M. J. M., of Yonkers, N. Y., in a recent issue of your magazine, I should like to say: The gallfly belongs to the phylon Arthropoda, of which there are about 400,000 species. The first traces of these animals are found in the Cambrian period which is dated at least 500,000 years ago. Three-toed horse fossils have been found in the rock of the Oligocene which was from thirty to forty million years ago. During the intervening period of about 470,000,000 years the arthropods had a long time in which to develop. As a result they became highly diversified and specialized. Hence there is little or no noticeable change between the fossils of 30,000,000 years ago and the descendants living today. This should clear up the problem raised in the letter by M. J. M.—R. M. L., Evanston, Ill.

Is There Any Way of Making This Water Do as Bid?

MANY years ago I tried to pull water from a lower level than the level of water in a large bell-shaped tank having an open bottom with a hose going to a small tank, as is shown in the drawing. All air was excluded and both the bell-shaped tank and the hose were sealed against any air getting in. Let us estimate the weight of water in the bell-shaped tank at 2,000 pounds and the weight of water in the hose at fifty pounds. With this big difference in weight, wouldn't you think the water in the bell-shaped tank would quickly suck the water out of the small tank? Well, it won't. As I have always been solid bone from the jaw up, I have never been able to find out why it won't. I did discover, by this experiment, that I could make water flow in either direction in the hose by raising or lowering the small tank. But that, of course, is merely the siphon principle and as old as the hills. What got my goat was that the heavier weight did not effect the lighter weight. Now, then, will some one please tell me why it didn't?—J. C. H., Hart, Mich.



Explicit Directions for Making Rainbow Sign

THE question of G. F. M., Mariners Harbor, N. Y., in Our Readers Say recalled to mind instructions I once read for making a rainbow sign. I believe the changing light feature would readily apply to his proposed aquarium and flower stand. The materials required are three light sockets arranged in a circle or cluster and wired in multiple, three flasher buttons which are sold by most electrical stores at about thirty cents each, and three bulbs, one each of the three primary colors red, blue, and yellow. One of the flasher buttons is slipped into each socket before the bulbs are screwed in, and as the flashers work independently, various combinations of bulbs will be in action at different times according to your color scheme.—W. G. W., Martins Ferry, Ohio.

All the World Needs a Cop to Keep it on the Jump

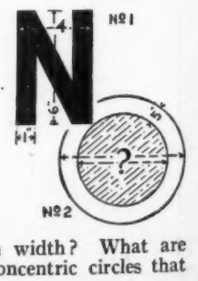
I BELIEVE that world conditions demand an international police system. Although subordinate to the League of Nations, such a system would have more power than the League now has and would increase the prestige of the League throughout the civilized world. There would be no such thing as extradition because the authority of the world police would be greater than that of any one nation since it would represent all nations. I should like it known that I suggest the formation of this police system to carry out the decrees of the world court, to protect international trade, and to try at least, to make the world safe for humanity.—S. N. P., Niagara Falls, N. Y.

This Is a Public Fight So Anyone Can Get In

THIS problem has caused a heated dispute and I would appreciate it if one of your readers could tell me the exact truth: "A" claims that solder will not erupt from a pot of molten metal unless water or some other object is thrown into the pot, thus knowingly causing it to erupt. "B" claims that solder will erupt from a pot of molten metal as the result of a chemical reaction taking place when the pot is taken off the fire for a few minutes and then put back on the heat. He also claims that sweating in extreme cold will result in such an eruption. Will some reader please answer this as soon as possible and so end the scrap?—A. M. L., Brooklyn, N. Y.

Couple of Easy Fellows for Sharks at Geometry

PLEASE publish something about the common practice and kinks of mechanical drawing, as it is a universal language and should have a wide appeal. Here are two problems in geometry that I wish you would submit to your readers: How do you find the area of the letter (N) when it is six inches high and four inches wide, having all its bars one inch in width? What are the diameters of two concentric circles that



are five inches apart, the circumference of the smaller circle being three-fifths of the larger one? These two brain teasers have occupied me for a long time but I am sure many readers will have no trouble in dashing them off and ending my suspense. I shall be relieved when I have their solutions.—G. H., Lohrville, Ia.

He Uses a Jawbone to Flay the Evolution Critics

IN OUR Readers Say, I see that C. C. J., of Nanticoke, Pa., claims that evolutionists have no proof that man descended from a mammal and that the entire theory of evolution is guesswork. As a matter of fact, scientists have definite proof that man descended from a mammal in the series of skulls and jawbones dating back to far more than 100,000 years. Everyone who has read the Origin of Life and dozens of other books on evolution knows that complete and flawless records exist in the fossils of horses, dogs, and other animals which clearly show the gradual development of these animals. Man has been in existence for at least 500,000 years and a great deal of change and development has taken place during that time. Still living are the aborigines of Australia and the pygmies of Africa who certainly are lower forms than the highly intellectual Nordics. C. C. J. is anxious for man to develop into something new. Just give him a chance. Meanwhile, his present form is not so entirely unsatisfactory.—B. R., Brooklyn, N. Y.

Maybe Wisconsin's Water Is Lighter Than the Rest

YOUR article in a recent issue about breathing under water through a tube, is wrong. Several years ago, I did this very thing. I breathed through a garden hose connected to a block floating on top of the water. I sat submerged in five feet of water, holding myself down with a stone, and stayed there for five minutes. When I heard the boys tell me the five minutes were up, (which I could hear through the tube in my mouth), I came to the surface. However, my temples were purple with the strain, and I was under the doctor's care for two days. On the other hand, some of the other boys did the same trick under five feet of water for several minutes each. I can furnish witness to prove the above statement, and I can also do the trick again at any time before any audience, and prove this can be done.—O. M. M., Milwaukee, Wisc.

Colored Sand Is Wanted To Set-Off These Fish

I AM interested in raising tropical fish and should like to obtain some information on the care of the tanks for them. I should like to know if there is some way of coloring the sand with some dye that will not injure the fish in any way. I should like to know if vegetable dyes would be satisfactory. I am a reader of POPULAR SCIENCE MONTHLY and I don't believe there is a finer magazine on the market. I should appreciate the information for which I have asked if any of your readers who may be engaged in the delightful, profitable, and at present popular occupation of raising these remarkable tropical fish, can supply it.—D. R. F., Chicago, Ill.

Confusion of Terms Was What Bothered That Spring

IN ANSWER to H. J. P.'s question "What happened to the energy stored in the compressed spring?" my answer is: He confuses power to produce with energy that is produced. The compressed spring never had any energy in it. The person compressing the spring put energy into the work of compressing it, and not into the spring itself, Clouds during a storm have the power, under certain conditions, to produce millions of volts of electricity. But energy is produced only when the lightning or electricity acts. The engineer of a steamship with thousands of horsepower, has the power to propel the ship across the ocean. But the ship will stay at the dock unless energy is produced by starting the engines working. A watch, with spring wound tightly but not running, has no energy in it but the spring has power to produce energy when the watch is started. Hence, the acid destroyed the power of the compressed spring to give forth energy.—C. S. Y., Brooklyn, N. Y.

Dear Old Kaleidoscope! Gone, But Not Forgotten

WHAT'S become of all the old kaleidoscopes? About forty years ago, no parlor was considered complete without one either on the center table along with the wax fruit and flowers and family album, or over on the whatnot in the corner with the dried starfish, sea horse, and whale's tooth. Oh, yes, you were nearly sure to find the kaleidoscope some place in every well regulated parlor forty years ago. And what a grand excuse it made to sit up close. I haven't seen one since Noah wore knee pants. Where are they? Why not add to your wonderful, and valuable Home Workshop Blueprints or Our Construction Kits, a description of, and how to make, a real old-fashioned kaleidoscope? Not one of those little paper tubes you had to hold in your hand, but the real thing, mounted on a stand, looking like a young telescope, about four inches in diameter and sixteen inches long, as I remember them.—R. S. W., Elverson, Pa.

This Reader Would Like to Build a Microscope

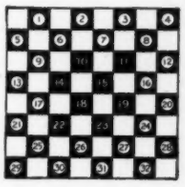
YOUR articles on the use of the microscope have been very interesting and educational. May I suggest that I should like to see directions published for making a microscope? I am aware of the difficulties involved in building such an instrument, but they would only add spice to the undertaking.—C. J. S., Cleveland, Ohio.

Honolulu Praises Our Readers' Tolerance

I HAVE been a constant reader of your magazine for a long time and can truthfully say that it has maintained that interesting and instructive quality which has made it popular with its readers since the magazine was first started. Though I have no particular choice as to the type of articles, I always start looking through the magazine from the Home Workshop. After this I read the other articles. I always get a lot of kick looking at Our Readers Say page. For that reason I leave it to the last. What a study in human nature and men's diversity of thoughts and desires! Some want this, some want that. But I see with a lot of satisfaction that the majority of your readers are tolerant of the other fellow's likes and dislikes and not inclined to force their own desires upon other people.—R. M. O., Honolulu, T. H.

Here's a Simple Problem for Your Checkerboard

ON A common checkerboard arrange the twenty-four men on the playing squares around the edge of the board. When two men adjoin each other diagonally, as on 27 and 32 with a vacant space on one side as at 23, you may jump as from 32 to 23, removing the piece on 27. A red piece may jump either a red or black piece and vice versa. All pieces may jump both forward and backward. As a suggestion, you may jump 32 to 23; 20 to 27; 31 to 24; 28 to 19, and etc. The object of the problem is to jump and remove all but one piece. I have met no one who can do this, although I have been assured that it is possible. Can any of Our Readers help me?—B. A., New York, N. Y.



We Published a Circuit Some Months Ago

PERHAPS you will think I'm crazy, but I am interested in radio control. For instance in a recent issue there is an article telling of a German who built a radio controlled boat. Where could I get information on the subject?—C. B., Mount Vernon, N. Y.

Here, at Last, Are Serious Suggestions for Changes

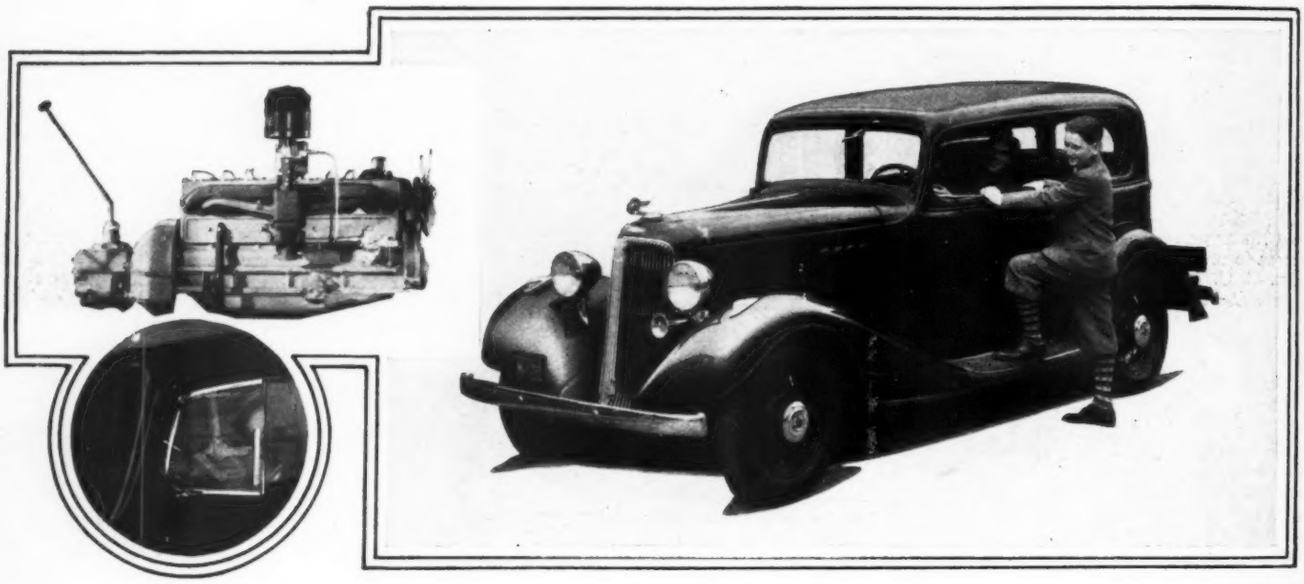
REFERRING to the suggestions you receive for changes in your magazine, I have a couple I should like to make. Why not publish more about cow feeding and hog calling? And let us have a lot more about freaks. In fact, why publish a paper devoted to general science and leave out so much that might be said about how we all sprang from monkeys? Suddenly growing serious, allow me, Mr. Editor, to remark that I start with the first article in your magazine and leave no page unread until I have finished the last word on the back of the last cover. Then I often start in and read it all again, from the back forward. Not that I have nothing else to read, either. Out of seven magazines and two dailies, I read POPULAR SCIENCE MONTHLY first every time.—W. E. H., Minneapolis, Minn.

Model Railroad Scenery Is What He Now Wants

AS AN enthusiastic reader of POPULAR SCIENCE MONTHLY, I am writing to thank you for being of so much help to me in building my model railroad. I have found your articles exceedingly helpful. As yet, I have not tried to make my own engines or cars but I have laid standard track on wooden ties as you recently suggested. What I should like to get now are some hints on scenery. This is the one thing I cannot get to look right. Can you help me? Also I saw in Our Readers Say a letter about lights that will turn red, stop the train; turn green and start the train. I should like to know the how and the why of this if some reader will tell me.—A. W., Haddon Heights, N. J.

Balanced Features *Engineered* and *Built* to give you BALANCED VALUE

APPEARANCE · COMFORT · PERFORMANCE SAFETY · DURABILITY · ECONOMY



Modern engineering is so highly developed that it is possible to emphasize any of these characteristics to an abnormal degree, and in this way give a car extraordinary speed, for example. In doing so, however, some other quality or qualities must necessarily be sacrificed. Most cars, therefore, are really engineering compromises, with the emphasis placed upon this or that characteristic as the manufacturing objective demands.

Pontiac is the car of Balanced Value, because it was deliberately designed and built to give you all the characteristics of a really fine car, so balanced and related to each other that it offers a sum total of car values that is altogether new to the low price field.

Read the Booklet

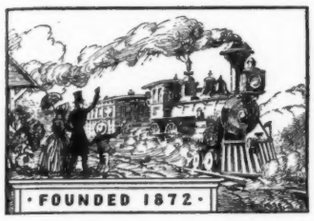
"What Do You Mean—Balanced Value"

This little booklet tells the engineering story of Pontiac's Balanced Features in terms of Owner Values. It is free. You can get a copy from the nearest Pontiac dealer—or write direct to Pontiac, Room 15-266, General Motors Bldg., Detroit, Mich. Be sure to read it. It will give you the basis for becoming a more critical judge of motor car character—and a better buyer.

PONTIAC THE ECONOMY STRAIGHT EIGHT

$585 AND UP F.O.B. PONTIAC EASY G.M.A.C. TERMS

A GENERAL MOTORS VALUE



POPULAR SCIENCE
MONTHLY

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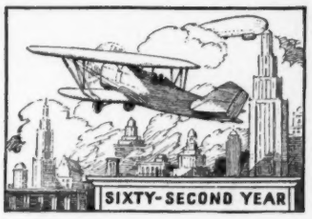
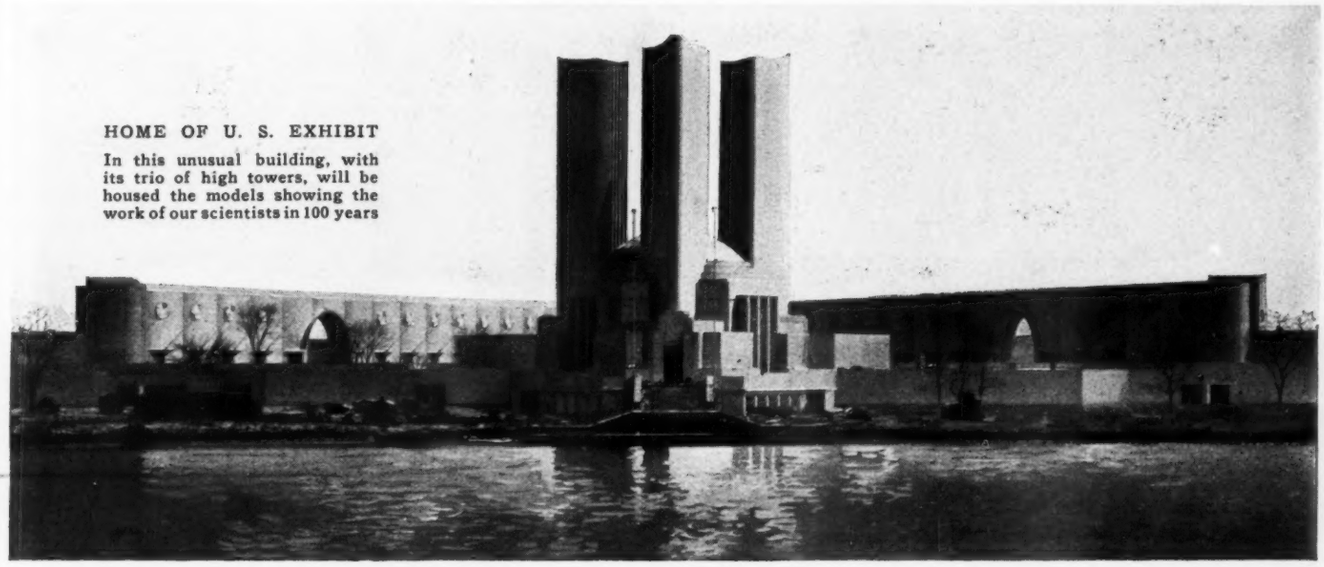
RAYMOND J. BROWN, *Editor*





HOME OF U. S. EXHIBIT

In this unusual building, with its trio of high towers, will be housed the models showing the work of our scientists in 100 years

Uncle Sam's Scientists

DISPLAY THEIR CONTRIBUTIONS TO PROGRESS

at Great World's Fair

By GEORGE H. DACY

ACCOMPLISHMENTS of United States Government scientists, during the past one hundred years, will be revealed by impressive exhibits at the Century of Progress exposition which opens at Chicago next month. A building of unusual design, decorated in bizarre color combinations, will house the remarkable display.

No scientific or technical exhibit ever set up exceeded in scope, variety, splendor, and magnitude the continuous performance Uncle Sam will stage in this windowless Federal Building with its trio of sky-pointing towers representing the executive, judicial, and legislative branches of our government.

At a time when Washington bureaus and offices are undergoing severe financial curtailment, when all costs of government operation are being pruned to the quick, Uncle Sam has to don his formal finery and show his wares. Let no one make the charge that participation in this exposition is a waste of national funds in a time of need. It is, on the contrary, a vindication of the unending and unavoidable costs of government, for the government exhibits demonstrate exactly how the nation pays enormous dividends, in its essential services to the general public, for the many millions of tax dollars collected annually.

One authority has described the Century of Progress as a symbol of industrial confidence. Although the exposition is being put on at a time of commercial and financial stress, nine million dollars of the ten millions in bonds to finance the fair have been sold. Financial magic was worked at a time when general prosperity was at low ebb.

The exposition was planned several years ago in celebration of Chicago's one hundredth birthday. Nineteen foreign countries, forty-four states, and the Federal Government accepted invitations to be represented, and despite hard times $25,000,000 has been spent on the big fair. Chicago hopes to entertain 25,000,000 visitors during the show season from June until November, one for each dollar invested in buildings.

One of the most striking of the government exhibits is a colorful reproduction of Mt. Rainier in Mt. Rainier National Park, down whose side, past a camping party in miniature, will course a glacier of real ice with a base of living pine and fir trees. The glacier is the product of electrical refrigeration. Tubs of brine, sunk beneath the miniature mountain, create rough, smooth, and piled-up ice. The top of the mountain and

Real ice, made by electric refrigeration, will form a glacier moving down the side of Mt. Rainier which will be the dominating feature of the Government's Mt. Rainier National Park exhibit

background are painted in oils. An intricate lighting system presents changing cloud effects and a realistic simulation of sunrise, sunset, daylight, and darkness. Motion pictures of vacation and touring scenes in the national parks are shown to the miniature tourists around the campfire in such manner that the spectators also may enjoy them.

The Hoover Dam, greatest engineering feat of its kind, is represented by a faithful working model of dam, power plant, and its related works. It is built on the scale of one inch to thirty feet and is mounted against a diorama, a semi-circular back-drop that gives a realistic impression of a distant stretch of the Colorado River and a section of the surrounding sun-baked mountains of Nevada and Arizona. Water, rushing over the model, combines with shifting light effects to add reality to the spectacle.

Another mechanical exhibit consists of six model groups mounted on an electrically-controlled revolving platform of steel, which represents important stages in our highway development. A miniature stage coach halted at a Colonial inn, models showing the race between the historic Tom Thumb locomotive and a horse, the first primitive wagon-roads of the log cabin era, the bicycle age, the advent of the motor car, the first improved highways, and our best transcontinental trails of today are features of this exhibit.

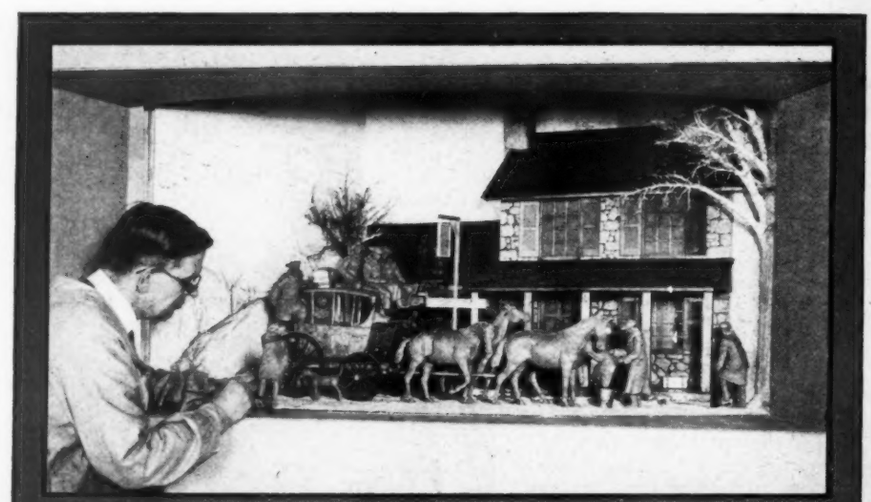
The revolving platform, on which these scenes are shown, is synchronized with a series of mechanized maps so arranged that a highway map of the period always is visible with each related scene of the diorama. This impressive exhibit tells the whole story of our national highways and transportation from the beginning of work on the famous National Road or Old Trails route (now U. S. 40) up to the present time.

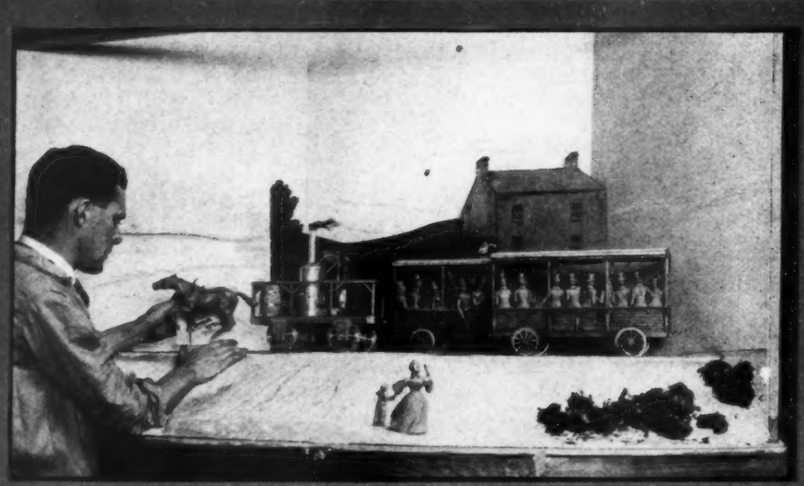
Every motorist who visits the Century of Progress will be interested in the tests of streamlined models of motor cars in a dwarf-sized wind tunnel supervised by engineers of the Bureau of Standards. This portable wind tunnel, designed and built for display at Chicago, is twenty-five feet long and is equipped with an electric fan, with blades four feet in diameter, capable of producing a sixty-five-mile-an-hour wind. A cutaway section in the wind tunnel has been faced with glass so that the spectators can watch the tiny automobile models mounted in the range of the artificial air blast, and at the same time see the special devices and gages that record the effect of the wind on a moving motor car.

One and one-half tons of steel have been delivered at the Federal Building on government order for tests in the jaws of a huge machine that reproduces the tests made for various industries by the Bureau of Standards in its Washington laboratories.

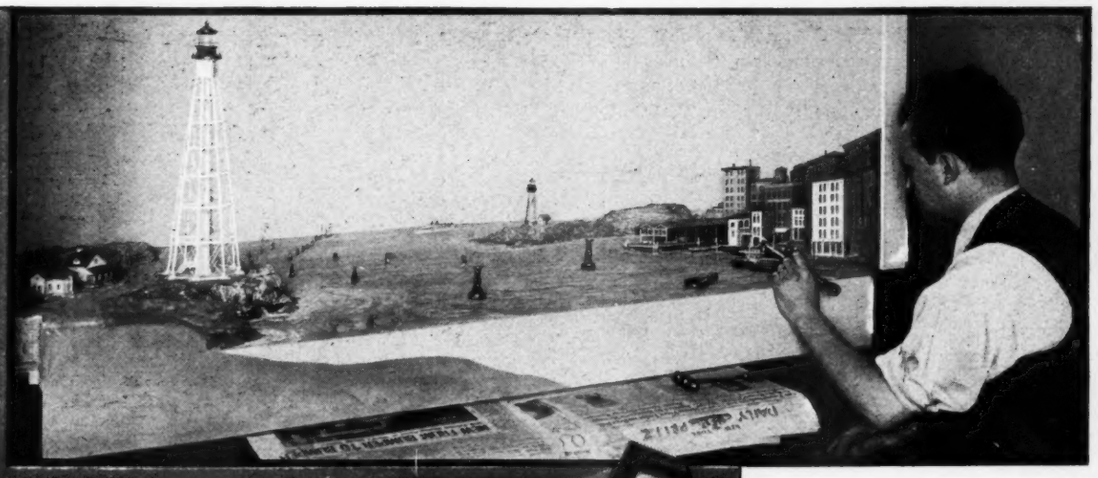
Operated under electric control, a new automaton tests the durability of leather samples for use as shoe soles. The samples are mounted on a perpendicular, rotating wheel that moves at right angles to another revolving surface faced with emery dust. Through the angles and mountings of these wheels, the leather is subjected to the turnings, twistings, and pressures it would undergo if made into soles. Twelve samples are tested simultaneously on this machine. About 40,000 revolutions of the apparatus occur before the best sole leathers fail and crumble to mincemeat. Rubber soles, floor tile, and linoleum are also tested in this practical way.

Another apparatus, recently perfected by the Bureau of Standards, consists of an electric recorder that tells how long paint, used as a protective coating on steel pipe, will last. The public will get its first glimpse of this automatic tester at the Century of Progress show.



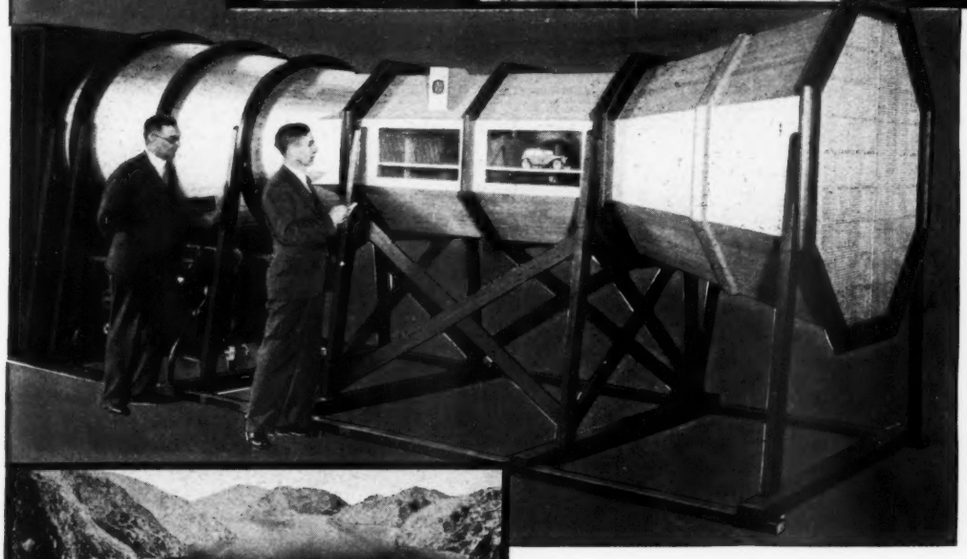


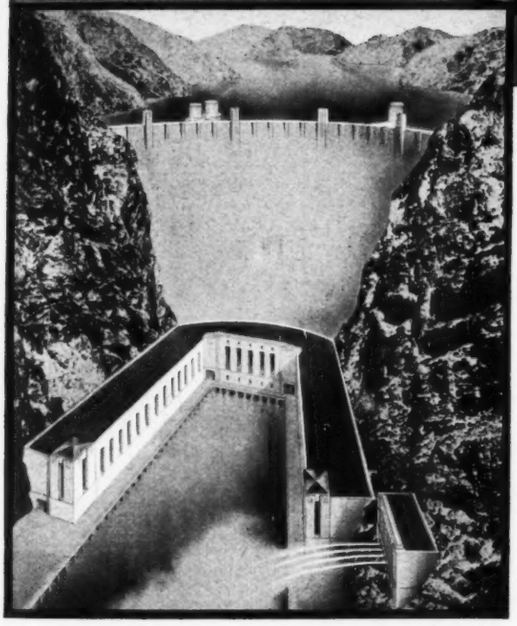
The famous race between a primitive locomotive and a horse will be dramatically re-enacted in Uncle Sam's exhibit. At top, stagecoach transportation as it existed in Colonial days will be shown in models which are accurate in every detail and which reproduce these vehicles



LIGHTHOUSE AND BEACONS

Visitors coming from the interior regions of the country to the World's Fair will be especially interested in this model of a lighthouse and beacons that will flash signals during the exposition. Complete in every particular, it will show how ships are guided to harbor by the light. Below, wind tunnel for testing cars





This model of the Hoover Dam, greatest engineering feat of its kind, will be part of the government exhibit

A bird sanctuary and game refuge constitutes another display, brilliant in natural coloring and so life-like that you watch attentively to see if the waterfowl, game birds, and wild animals are alive or mounted. This exhibit tells the story of wild life conservation and the federal stewardship of national timberlands. The attractive outdoor scene, looking as though it had been lifted bodily from some sylvan spot and moved indoors, is composed of trees and shrubbery so true to nature that you are amazed to discover they are artificial.

Stuffed specimens of upland game birds perch in these trees. Artificial ducks, mouths distended as though uttering raucous cries, and feet outstretched for a landing, hang suspended over an imitation pond. One deer drinks at a cool spring-fed stream while his mate, head lifted, stands alert for any sign of danger. A wild turkey gobbler and several hens add a touch of American realism. This exhibit illustrates how Uncle Sam cooperates with the states in protecting and conserving wild life against poachers, parasites, and predatory animals.

It also shows how timber is cut, replacement trees planted; demonstrates the value of timberland in conserving municipal water supplies and the importance of the forest terrain for live stock grazing.

Through plate glass you can study the heart of an artificial redwood tree, a giant from the California forest. You can count the birthdays of that mammoth tree in the plainly visible rings of growth.

The importance of forested areas that absorb rainfall and feed it gradually into the soil is demonstrated by an ingenious model in which pumped water percolates like rain through an illuminated channel. In one sector of this object lesson, the surface soil is bare and here the make-believe raindrops run away and go to waste. Another section, carpeted with grass, twigs, leaves, and matted debris, retains the water as it seeps slowly into the soil. A circulating pump, operated by electricity, forces the same water over and over through the restricted channels.

Mothers, housewives, and their daughters will be interested in a home economics' show visible through the windows of a three-walled home. Dining room windows will permit an inspection of the dietary problems of the average American family, solved by trained purchasing, seasoned selection, and skilled preparation of the proper foods. Through the living room windows they will be able to see parents hard at work balancing the budget. Another scene compares the wearing qualities of various textiles and shows how to get the most for your money when buying clothes.

Another striking exhibit, a real novelty to Fair visitors from inland places, will be a federal lighthouse, complete with beacons, bell buoys, sound signals, and radio outfits. How the flash and flicker of its powerful light guides storm-tossed ships to harbors of safety will be clearly demonstrated.

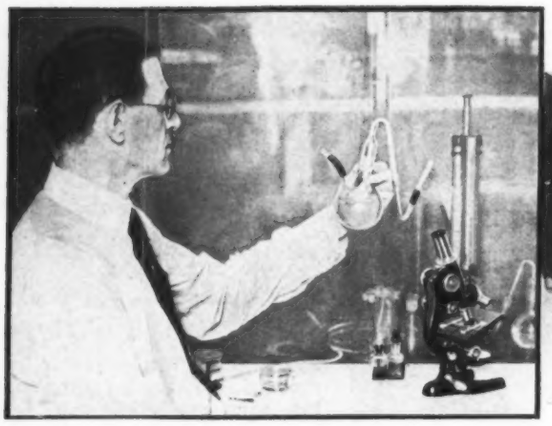
The War Department's share in the show will consist of a military encampment of 400 regulars, army maneuvers and daredevil riding by cavalry monkey-drillers, who equal the cleverest circus stars. The march of the infantrymen, the thunder of hoofs as the cavalry goes by, the blare of the military band, the precision of military formation, and small arms drill will give the visitor a glimpse of every phase of army life.

The Army's Corps of Engineers has made for the exposition a graphic bas-relief map of the proposed Nicaraguan Canal. Models showing proposed river and harbor improvements, and other similar activities of Army engineers, will be on display.

The U. S. Navy will feature an intricate and effective demonstration. In its animated exhibit, an ellipse fifteen by twenty-one feet represents the ocean with the United *(Continued on page 95)*

· Beer Making Is Marvel

Drawings by
B. G. SEIELSTAD



Worth its weight in diamonds is this flask of pedigreed yeast developed for brewers' use over a fifty-year period

CORN OR RICE MAY BE USED TO SUPPLY ADDITIONAL CEREAL STARCH

MALT (SOAKED and SPROUTED BARLEY) IS CHIEF INGREDIENT OF BEER, FURNISHING STARCH and ENZYMES. THE LATTER CONVERT THE STARCH TO FERMENTABLE SUGAR

CORN GRITS HOPPER

MALT HOPPER

MALT MILL CRUSHES MALT IN PREPARATION FOR MASH

MASHING "RAKES" STIR MIXTURE THOROUGHLY UNTIL MASH IS FORMED WITH HOT WATER

1 MASH FORMED OF MALT, CORN and HOT WATER IS KEPT AT 160 DEGREES. IN TWO HOURS, ENZYMES OF MALT HAVE TURNED CEREAL STARCHES TO SUGAR (MALTOSE) WHICH CAN BE FERMENTED

MASH TUB

HOP BIN

HOPS ARE ADDED DURING BOILING TO COUNTERACT SWEETNESS OF MALT AND CEREAL AND TO GIVE BEER ITS CHARACTERISTIC FLAVOR.

VENT PIPE

PRESSURE FILTER

SOLID MATTER IS EXTRACTED AND SOLD FOR CATTLE FEED - LEAVING CLEAR LIQUID

5 YEAST IS ADDED HERE and FERMENTATION BEGINS

4 LIQUID PRODUCT NOW KNOWN AS "LAGER" IS COOLED to PROPER TEMPERATURE FOR ADDITION OF YEAST

STARTING VAT

METERS RECORD TEMPERATURE OF BREW, STEAM PRESSURE, LEVEL OF BREW, etc.

3 "WORT" IS CONCENTRATED, STERILIZED and FLAVORED BY BOILING FOR 1 to 3 HOURS

2 FILTERED LIQUID NOW CALLED "WORT" and ESSENTIALLY A DILUTE SUGAR SOLUTION PASSES TO BREW KETTLE

COOLER

BREW KETTLE

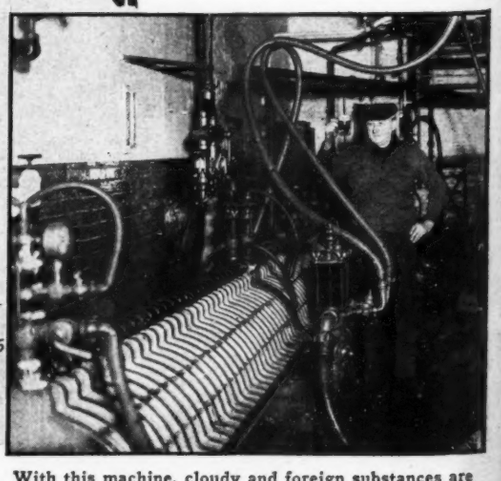
HOP STRAINER

STEAM VALVE

STEAM JACKET KEEPS BREW AT BOILING POINT

AGITATOR KEEPS SOLIDS FROM SETTLING

HOPS and SOLIDS FORMED IN BOILING ARE STRAINED OUT HERE



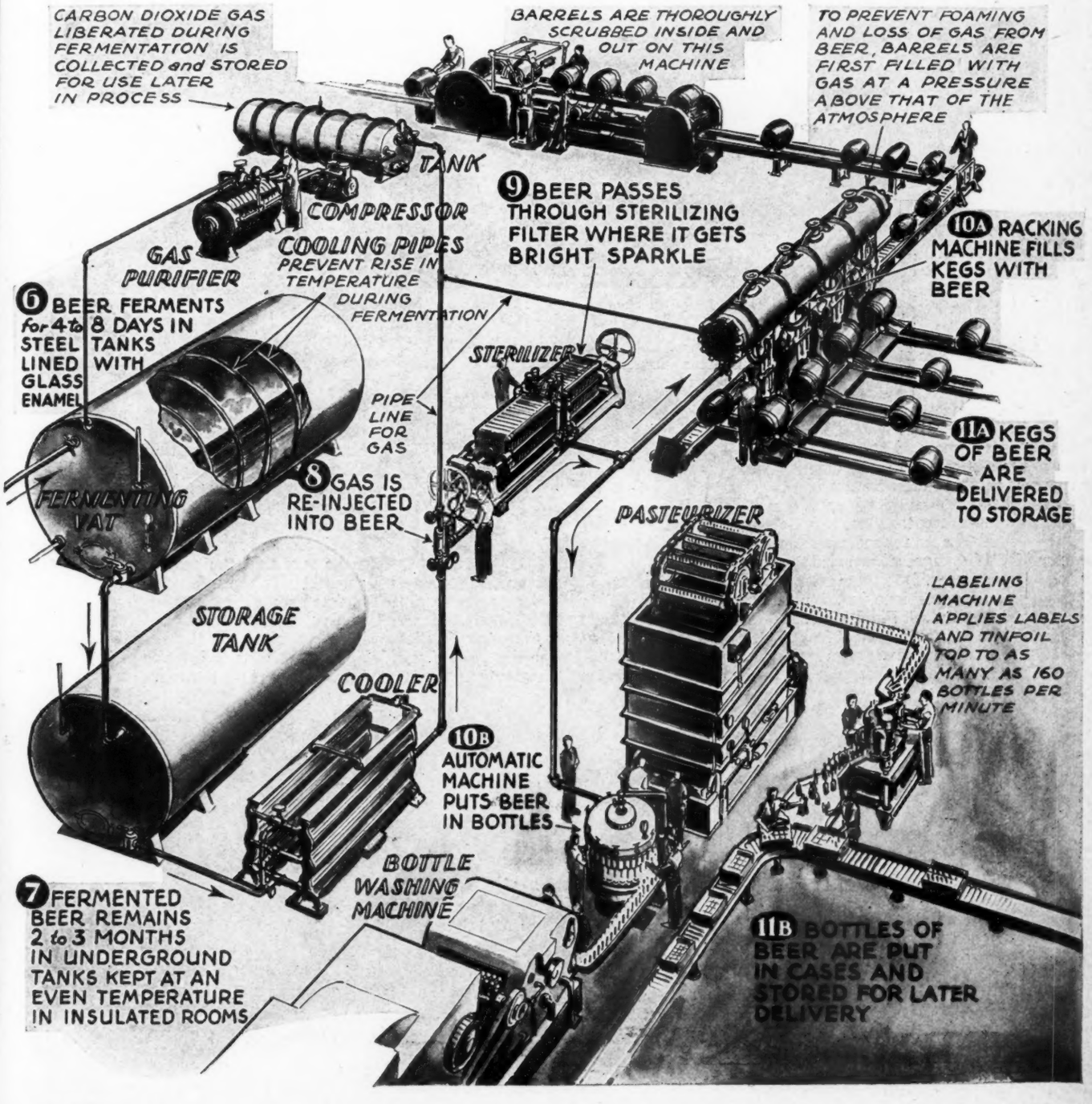
With this machine, cloudy and foreign substances are filtered out of beer, thus greatly improving its quality

# of Industrial Chemistry ·

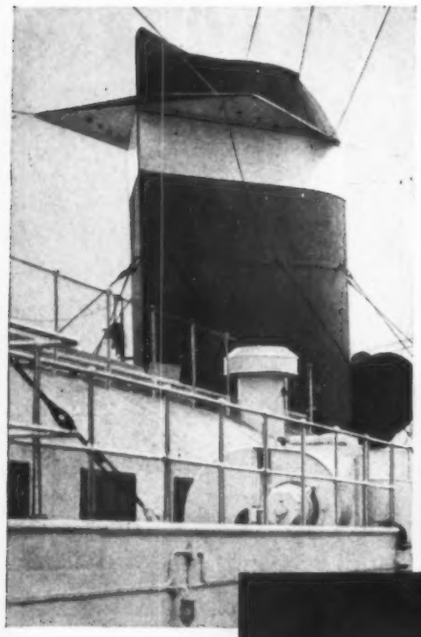
With the removal of national restrictions against the manufacture and sale of beer, American brewers are again in action. Their operations represent one of the most extensive applications of modern industrial chemistry. More than 2,000,000,000 pounds of malt, 650,000,000 pounds of corn and corn products, and 41,000,000 pounds of hops are a part of the vast consignment of raw materials that experts will turn each year into beer. On these pages, our artist shows how the transformation is accomplished in one big, and now active, American brewery.

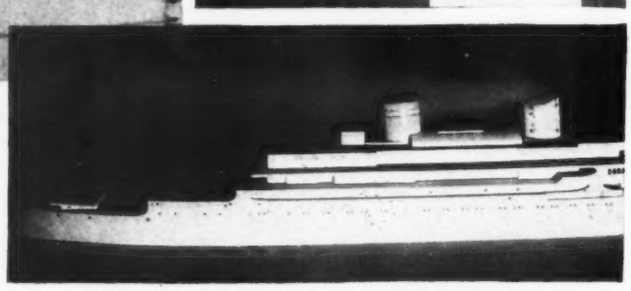
Beer is the fermented product of malted or sprouted grain, usually barley. Its manufacture requires the conversion of the grain's starch into fermentable sugar, and the transformation of this sugar, by fermentation, into alcohol and carbon dioxide gas. During the process, the beer is given its characteristic bitter flavor by the addition of hops, the yellowish-green cones or catkins of the hop vine.

Malt, the principal raw material, has previously been produced by steeping, sprouting, and drying barley. Germination develops an important enzyme or digestive fluid called diastase, capable of turning the malt's starch into sugar. Since this task does not exhaust the enzyme's power, additional starch in the form of corn or rice is often added at the start of the brewing operation. Subsequent steps from the mash to the final product are explained in the drawings. The color of the finished beer depends upon the raw materials; natural malt yields a pale beer, while caramelized, or heat-treated, malt gives a dark beer.


CARBON DIOXIDE GAS LIBERATED DURING FERMENTATION IS COLLECTED and STORED FOR USE LATER IN PROCESS
BARRELS ARE THOROUGHLY SCRUBBED INSIDE AND OUT ON THIS MACHINE
TO PREVENT FOAMING AND LOSS OF GAS FROM BEER, BARRELS ARE FIRST FILLED WITH GAS AT A PRESSURE ABOVE THAT OF THE ATMOSPHERE
TANK
COMPRESSOR
GAS PURIFIER
COOLING PIPES PREVENT RISE IN TEMPERATURE DURING FERMENTATION
9 BEER PASSES THROUGH STERILIZING FILTER WHERE IT GETS BRIGHT SPARKLE
10A RACKING MACHINE FILLS KEGS WITH BEER
6 BEER FERMENTS for 4 to 8 DAYS IN STEEL TANKS LINED WITH GLASS ENAMEL
STERILIZER
PIPE LINE FOR GAS
11A KEGS OF BEER ARE DELIVERED TO STORAGE
FERMENTING VAT
8 GAS IS RE-INJECTED INTO BEER
PASTEURIZER
LABELING MACHINE APPLIES LABELS AND TINFOIL TOP TO AS MANY AS 160 BOTTLES PER MINUTE
STORAGE TANK
COOLER
10B AUTOMATIC MACHINE PUTS BEER IN BOTTLES
BOTTLE WASHING MACHINE
7 FERMENTED BEER REMAINS 2 to 3 MONTHS IN UNDERGROUND TANKS KEPT AT AN EVEN TEMPERATURE IN INSULATED ROOMS
11B BOTTLES OF BEER ARE PUT IN CASES AND STORED FOR LATER DELIVERY

FINS KEEP SMOKE FROM SHIP'S DECK





Fins on the smokestack, above, deflect the smoke from the liner's deck. At right, lower view shows how smoke from ordinary stack trails across the deck. Upper view shows test stack with fins deflecting smoke

SEEKING a way to keep smoke from annoying passengers on upper decks of liners, New York engineers recently exposed ship models to a breeze in a wind tunnel and pumped smoke up the miniature funnels. The path of the smoky trail, they found, depended on the funnel shape. From the resulting data they designed a new airplane smokestack that deflects smoke currents, by means of fins resembling those on the tails of aircraft. The odd funnels have been installed on four new liners plying between New York, Central America, and California, and are reported to have worked with notable success.

PLANE FOLDS TO FIT SPACE IN SUBMARINE

ONE of the oddest needs of naval aviation is an airplane that will fold into the least possible space. Experiments have shown it practicable for a submarine to carry such a flying craft in a watertight tank on its deck. Whenever the undersea vessel comes to the surface, the plane may be assembled and launched for scouting. American and British designers have vied to produce suitable planes. Latest and most compact is a Loening seaplane just completed and tested at Roosevelt Field, N. Y. It can be folded into a space only eight feet wide; but its extended wings have a span of thirty-one feet, as shown in the photograph below.

Above, image of fly as it is seen in the glass shown at right

TINY TUBE MAGNIFIER ENLARGES FOUR TIMES

LIVE insects and other objects for study may be placed inside a new vest-pocket magnifier. Its hollow barrel is capped at one end by a lens, and at the other by plain glass. When held to the light, the device enlarges the specimen four times.

DOUBLE-CROWNED HAT SUITS ANY SEASON

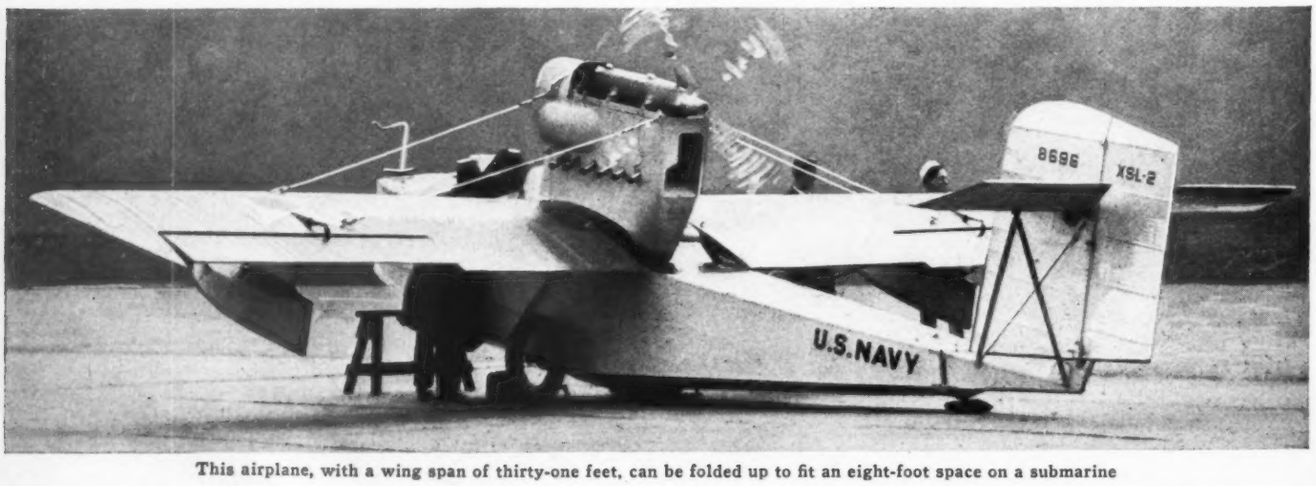
EQUALLY suited to mild or torrid weather is a novel headpiece invented by a hatter of Liverpool, England. A detachable crown may be removed when the mercury goes up, as shown in the illustration above, and perforations in the inner crown provide adequate ventilation for the head.

CANCER GERM REPORTED FOUND BY TWO DOCTORS

STARTLING to the medical world is a recent tentative announcement that the germ of cancer has been discovered. For many years it has been supposed by many authorities that cancer is not a germ disease, and therefore non-communicable and incapable of being treated by a serum. This theory will be upset if experiments of Drs. T. J. Glover and J. L. Engle, two New York City physicians using the facilities of the U. S. Public Health Service at Washington, D.C., are confirmed.

The two men, according to their report, have isolated spore-bearing germs from the tissues of a proved case of cancer of the human breast. When the germs were injected into a guinea pig, the animal developed typical cancerous growths that spread through its body.

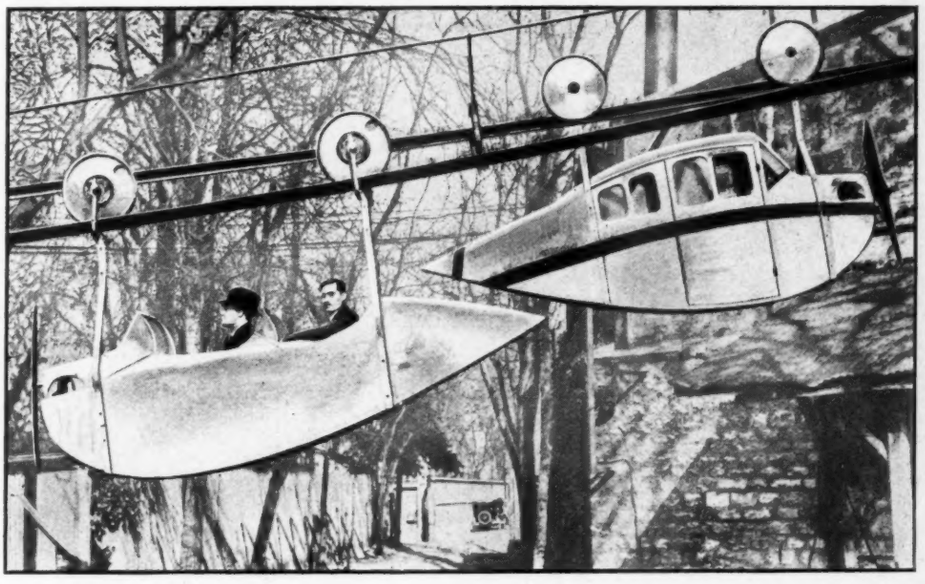
Not all leaders in cancer research are convinced, and further tests are planned to make sure that the germ observed is responsible for the infection. If so, the experimenters will seek to learn whether all kinds of cancer or only one form are germ-borne. Because of the lengthy research needed, the tests will not be of immediate benefit to cancer sufferers.



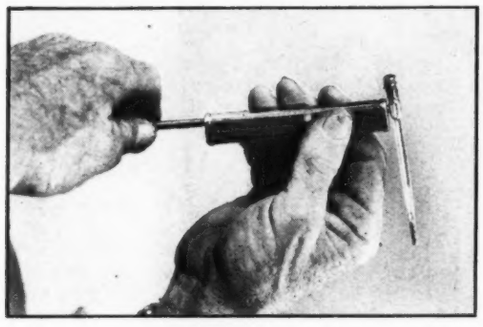
This airplane, with a wing span of thirty-one feet, can be folded up to fit an eight-foot space on a submarine

Propeller-Driven Car Hangs from Monorail

AN IMPROVED airline cab, capable of 155 miles an hour, is the latest invention of the French engineer who developed the trench mortar used during the World War. Suspended on monorails, the cabs resemble airplane fuselages. A small propeller at the front of the cab is driven by a fifteen-horsepower electric motor. The monorail, which guides the car, also furnishes the electric power for the motor. The inventor has been working on air cabs for over eleven years and has constructed many designs as well as complete air rail systems, many of which underwent severe test successfully but were found too expensive for practical use. In the photograph, two of his airline cabs are shown suspended from the monorail along which they are expected to run at high speed.



SPRING SHAKES CLINICAL THERMOMETER



AFTER forty years of shaking clinical thermometers before taking the temperatures of his patients, a Los Angeles, Calif., doctor has invented a carrying case that does the work by centrifugal force. After unscrewing the thermometer from its case, it is slipped through a clip at the opposite end. Pulling out a spring plunger and allowing it to snap back into place, rotates the thermometer and the separated mercury is rapidly settled to insure accurate readings of patient's temperature.

ROLL-UP SAIL DRIVES NILE BOATS

NATIVE boats plying the Nile use queer rectangular sails seen on no other waters of the globe. Rigged like a curtain on a pole, the single sail can be rolled or unrolled merely by turning the boom. If more sail is required, the entire sail is lowered until the spoked end of the boom is within easy reach of those on deck. The canvas is then unrolled the required amount. If less sail area is needed, the sail is rolled on the boom. Because of the changing wind conditions in the Nile Valley and the sand bars that spot the river, an easily-controlled sail of this type has its advantages. When landing, the rectangular sail is completely rolled on the boom which is lashed vertically to the small stub mast so that no wind can catch it.

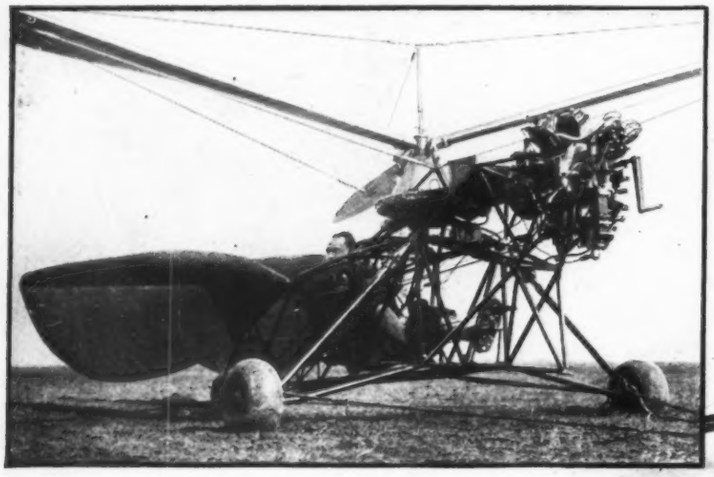
Photo at left shows the rectangular sail used on boats on the Nile being furled by winding it around the mast. Below, the sail is seen hoisted to catch the river breeze

This adjustable lamp has a rigid supporting arm with joints so it can be arranged in any desired position to illuminate all parts of work

ADJUSTABLE LAMP FOR GARAGE WORK

HAVING a rigid supporting arm that can be adjusted to any position, the lamp standard shown above is particularly valuable in shop and garage work. The carefully shaded light can quickly be placed in a position six feet above the ground or at the floor level—and the easy-working joints in the arm make any complicated angular adjustment possible. With this trouble lamp, no bothersome hooks or clamps are needed to hold it in position; once adjusted, the light remains in place. A wide wooden base and a strong pipe standard also make the light particularly rigid and its stout electric cord keeps it practically short-circuit-proof.

New Helicopter Proves Its Lifting Power



DESIGNED to raise itself vertically and hover or fly forward at will, a new kind of helicopter showed promise in recent preliminary weight-lifting trials at Heston Aerodrome, England. When tethered by slack lines to stakes in the ground, it lifted front and rear wheels alternately under its own power. The lift is obtained from a three-bladed, horizontal propeller. Two long vanes or sweeps, resembling the tail feathers of a bird, are mounted at the rear to stabilize the odd craft. Full flight tests will be made soon and the designer is confident of success.

Rear end of new helicopter is being tied down preliminary to the test of its lifting power in England. View at upper left shows the three-bladed propeller designed to lift the plane when it is whirled by the motor in front

PILOT USES MIRROR TO REDUCE PLANE'S NOISE

BIG tri-motored planes, linking the United States with Central and South America, are now being made quieter with a simple alteration discovered by a transport pilot. His invention consists of a small mirror attached to the motor cowling as shown in the photograph above, in which the pilot can see the reflection of both the front and side propellers. By throttling his motors until the images merge, he is able to synchronize the propellers and reduce the noise and vibration that occur when they are out of step.

TRY CREOSOTE AS FUEL TO RUN ENGLISH CARS

CREOSOTE is being tested as a fuel for motor cars by engineers in Great Britain. A number of automobiles, recently designed, use the oily fluid, distilled from wood, to furnish power. Several such vehicles are said to be in operation.

AUTOGIRO HALTS FLEEING 'BANDIT' CAR

TO TEST an autogiro in a motor bandit chase, a driverless car recently was sent speeding across a field near Bryn Athyn, Pa. A windmill plane took off in pursuit, carrying Chief of Police Theodore Hollowell. Using a sub-machine gun, as at left, he peppered the car until a direct hit disabled it. Tracer bullets set the car afire. The end of the chase is shown below, with the autogiro about to land.

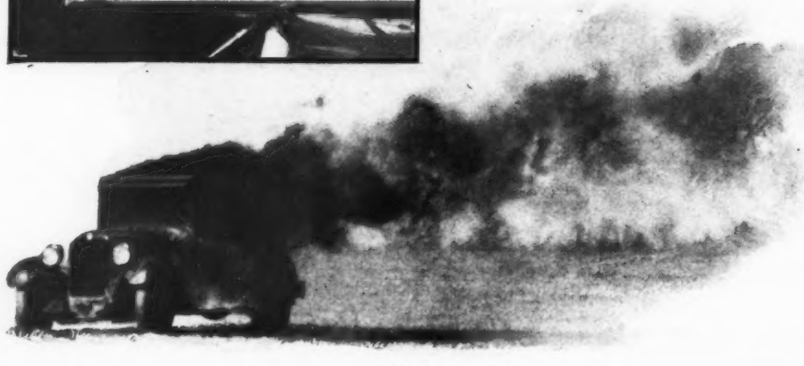


TABLE FITS YOUR AUTO

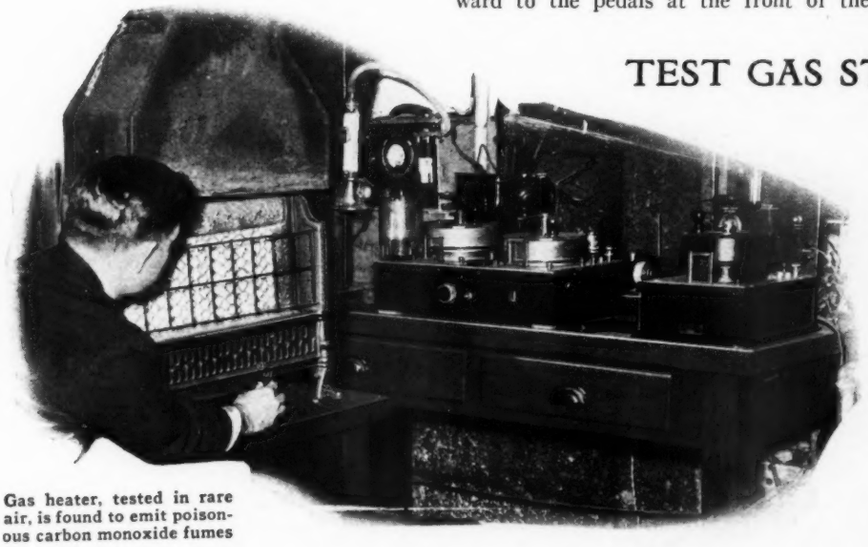
HANDY for light repasts, a new table may be installed in the back of the car simply by inserting four screw eyes around the sides of the interior. Adjustable supporting straps are then easily clipped on or detached. They hold the table at any desired height. The top is always level, as is shown in photo above.

Rider Lies Down on This Bicycle

French inventor demonstrating his new type bicycle upon which the rider reclines. Wind resistance is thus reduced and less effort in pedaling is required

DESIGNED for comfort and speed, a bicycle of unusual form is being exhibited by a French inventor. The rider reclines in a nearly horizontal posture on a padded seat, with his feet extended forward to the pedals at the front of the machine. In this position, the wind resistance is decreased and the bicycle may be propelled with considerable velocity. Not the least curious feature of the machine is its steering gear, a curved bar resembling a sawed-off steering wheel.

TEST GAS STOVES IN RARE AIR



Gas heater, tested in rare air, is found to emit poisonous carbon monoxide fumes

SEALING themselves in a test chamber for airplane engines, where rarefied air of high altitudes can be simulated, U. S. Bureau of Standards experts recently solved an alarming mystery. Household ranges and gas heaters, approved by leading laboratories, had been found to emit dangerous amounts of poisonous carbon monoxide gas at Denver, Colo. Tests showed the mile-high altitude, with its reduced air pressure, responsible. Flue gases expanded abnormally, blocking escape passages when gas was burned too fast. The data obtained by this unusual investigation will help re-design present appliances, which in some cases may require regulation by a service man to insure safety.

CARD ON WRIST SIGNALS CAR DRIVERS

A FLIP of the wrist enables a motorist to signal a driver behind him, with the aid of a new hand warning device tried out in England. A hinged card, white on one side and red on the other, is clipped to the wrist by an elastic. When a motorist is about to turn, he displays the red signal to warn the driver behind of danger; but a wave of the hand turns the card over and shows the white side, indicating it is safe for cars to pass on the driver's left-hand side.

Card, red on one side and white on the other, is clipped to the driver's wrist and with it he signals his turns to autos behind him

NEW POCKET CASE HAS EIGHT DISTINCT USES

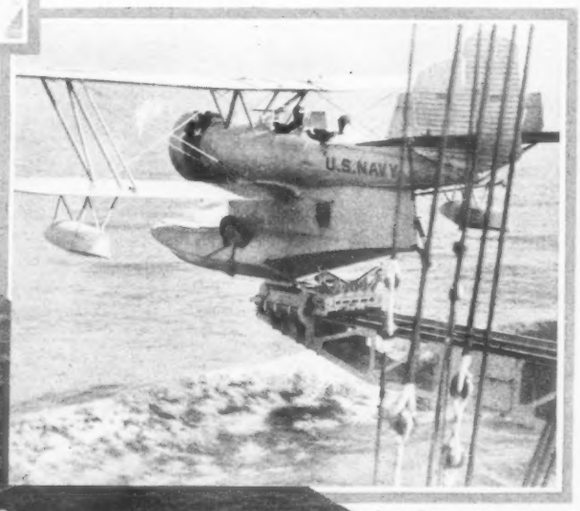
EIGHT distinct purposes are served by the versatile pocket case, illustrated above. A cigarette compartment occupies the center, supplemented by a concealed writing tablet, a telescoping pencil, and a stamp container. In addition the case contains a five-inch rule, a lighter, a pocket knife, and a watch. The entire outfit folds flat into small enough space to fit the palm of the hand and is so small that it can easily be slipped into your vest pocket exactly as an ordinary cardcase is carried.

Big Battleships Triumph

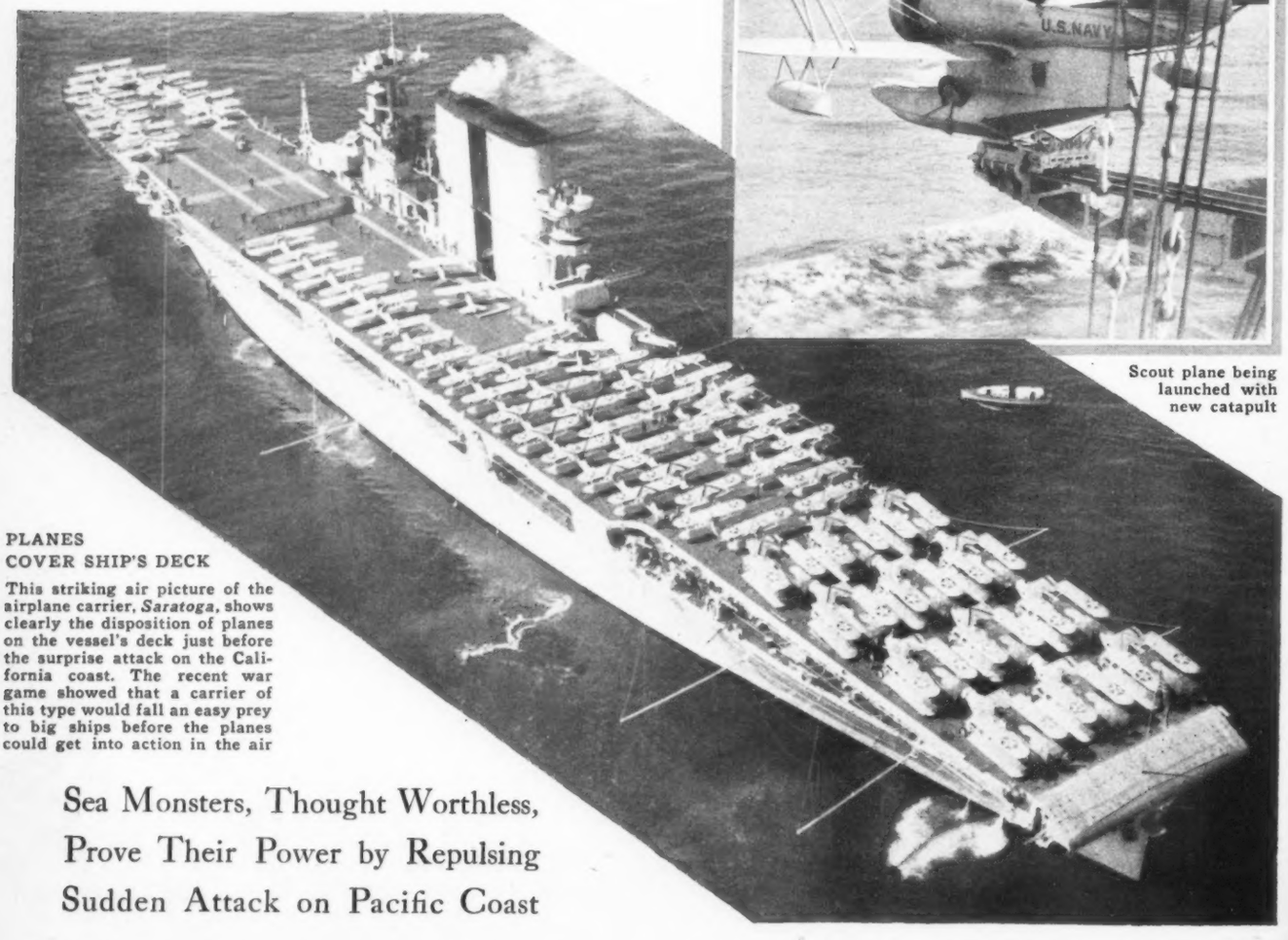
Over Bombing Planes in War Game

A scouting plane returns to its ship after gathering data as to the movements of the enemy. The pilot is hooking on the cables that hoist plane to deck. The ship picks up the plane without stopping

Defense destroyer *Lea* on picket duty near coast



Scout plane being launched with new catapult



PLANES COVER SHIP'S DECK

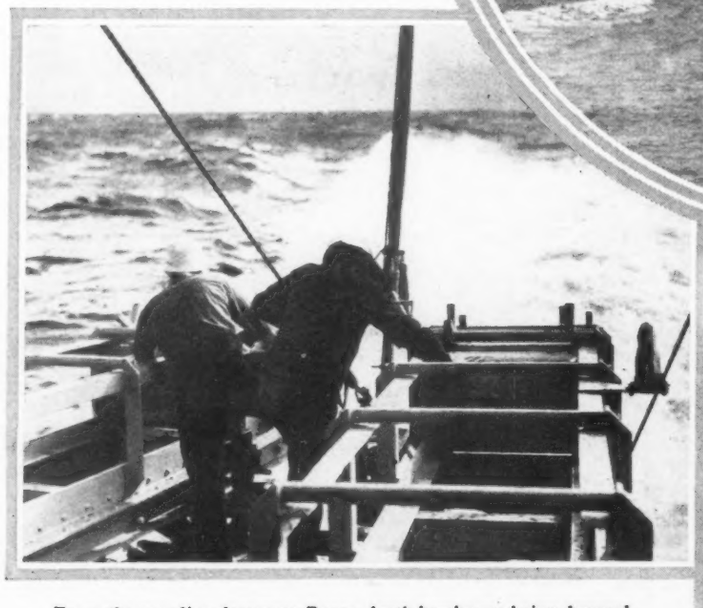
This striking air picture of the airplane carrier, *Saratoga*, shows clearly the disposition of planes on the vessel's deck just before the surprise attack on the California coast. The recent war game showed that a carrier of this type would fall an easy prey to big ships before the planes could get into action in the air

Sea Monsters, Thought Worthless, Prove Their Power by Repulsing Sudden Attack on Pacific Coast

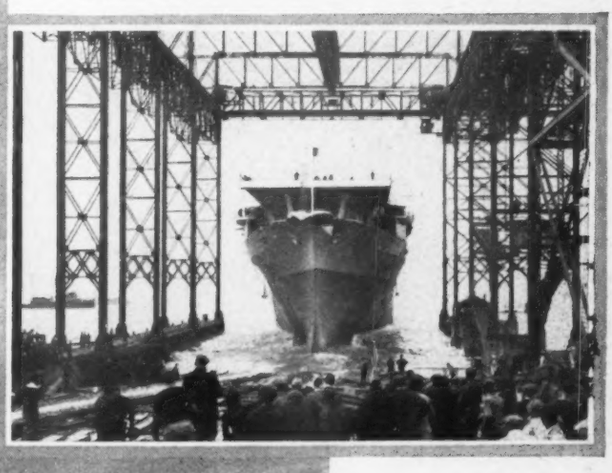
THAT the ships of the line can still guard a coast against surprise air raids was the lesson drawn from more than a month's maneuvers of the U. S. Navy in the Pacific, illustrated on these pages. Many observers were beginning to believe armored battleships were unfitted for modern naval combat. To test this idea, twenty-four of the Navy's fastest vessels, including the airplane carriers *Lexington* and *Saratoga,* raced toward the California coast in a surprise attack. From the moment the destroyer picket *Tarbell* gave the alarm, the big guns of defending battleships decided the outcome. Caught unawares, the carrier *Lexington* was "sunk" by the battleships *Oklahoma* and *Texas* without being able to launch a single plane. The battleship *Pennsylvania* "shelled" the *Saratoga* and chased the carrier to sea, while its planes still groped through fog in an ineffectual attempt to bomb San Pedro bases.

STATELY PARADE OF MONARCHS OF SEA

Battleships of the United States Navy give an impressive demonstration of power steaming along with the *Colorado* leading



From the speeding destroyer *Roper,* depth bombs are being dropped. One of these bombs will disable a submarine if discharged near it



Down the ways at Newport News, Va., goes the newest aircraft carrier, the *Ranger.* This is the first U. S. vessel designed especially as a mother ship for planes. The other carriers were converted from old battle cruisers

Fast cruisers, left, lay a smoke screen behind which the battle fleet can maneuver hidden from the scouts of the attacking forces. This defense measure was successfully carried out during the recent war operations off the coast of California

AMAZING SKILL *with* UNSEEN STRINGS

gives life to

Most Famous Puppets

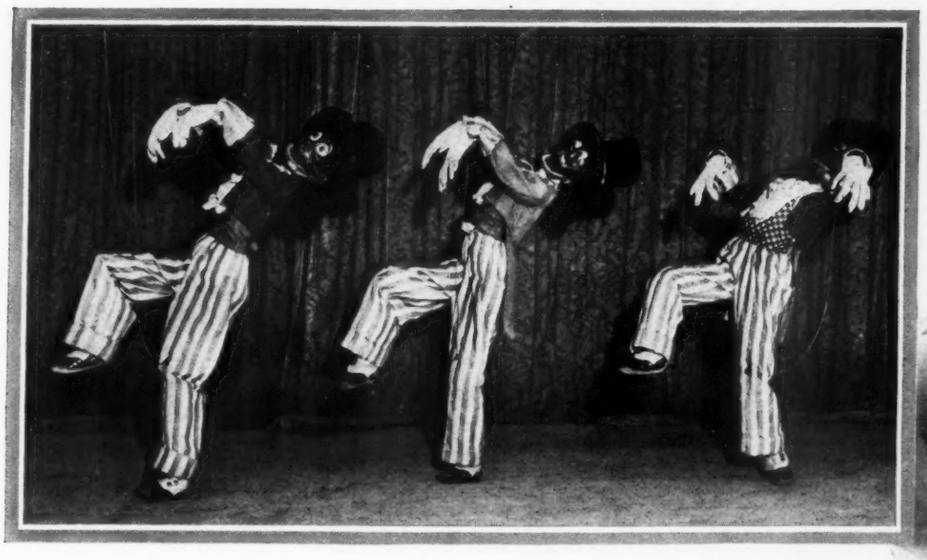
EIGHT hundred performers, moved by miles of wires and string, are now touring the country presenting the most elaborate puppet show of history. Known as the Teatro dei Piccoli, "The Theater of the Little Ones," the organization has spent eighteen years in Italy building up its cast. Tap dancers and opera singers, witches and clowns, bull fighters and pianists, acrobats and jubilee singers, and even a Mickey Mouse give animated performances, amazingly lifelike.

Ten million people in thirty countries have witnessed the 12,000 performances these remarkable marionettes have given. Yet the most interesting action of all has gone unseen. It is the drama that takes place behind the drops in the world of wire and mechanism which brings the puppets to life. These photographs, made especially for POPULAR SCIENCE MONTHLY, give you this glimpse behind the scenes.

On the "castle," an overhead platform at the rear of the stage, the puppeteers, who control the movements of the marionettes, operate the wires with the skill of musicians playing on harps. Every turn of the wrist, every movement of the fingers is vital to the action of the little ones on the stage below.

The puppeteers are recruited from families that have practiced the art for generations. In spite of this, seven years' training is necessary before an apprentice is ready to ascend the castle. A fine sense of rhythm and perfect coördination between mind and muscle are the two

Above are puppeteers on their balcony, working the strings that put the little wooden actors through their dances and lifelike action on the stage. At right, as the puppet pianist runs his fingers over the keys, an unseen musician plays and a singer in the pit synchronizes his voice with that of the puppet at extreme right



Three figures at left are made to dance in unison by the clever manipulation of the hidden strings that control them. Below, the puppet heads are artistically carved by real sculptors who take great pains to give each a realistic expression that suits its role

Thirty Operators Working Eighteen Miles of Wire and String Are Needed to Give a Performance with the 800 Animated Actors that Are Cleverly Molded of Wood

By

ROBERT E. MARTIN

This photo shows the flexible joints that are necessary to give the puppets their variety of movements

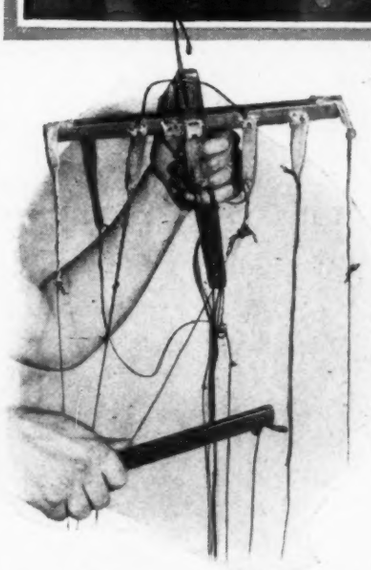
prime requisites for the work. Sometimes, four men are required to handle the wires of a single figure and their movements must be perfectly synchronized to make the actions of the puppet smooth and flowing.

Eighteen miles of wire and string are used in giving life to the 800 wooden actors in the cast. The number of wires attached to the figures range from three to thirty. In some performances, as many as twenty puppeteers are working on the castle platform at the same time and yet not a single wire of the apparently tangled maze is crossed.

The nervous system of each marionette is formed by cords or wires attached to two wooden handles that are held in the hands of the operator. One handle is shaped like a cross. It is held in the left hand and governs the position and maintains the equilibrium of the puppet. The other handle is simply a straight piece of wood. It is rocked back and forth in the right hand or lifted and dropped slightly to give motion to the arms and legs of the marionette.

In some cases, such as in the presentation of a dance by a troupe of chorus girls, a dozen figures are connected with wires so they all move in unison. One operator is all that is required to keep them dancing. He holds two wires like reins and pulls first one and then the other to keep the troupe in motion.

During the performance, the puppeteers lean over a bench-like railing at the edge of the castle platform, nine feet above the stage, wearing special padded leather aprons to act as cushions between their bodies and the hard wood. Often they become so engrossed in the action of the little figures below that they open their mouths when the puppets sing, tremble all over when an acrobat strains to perform a difficult feat, and clench their jaws as the little marionettes rush into battle.



To this cross are attached the wires and string that maintain the position of the puppet. The lower handle is used to operate legs and arms

At the same time, trained human singers and actors, hidden in the orchestra pit, speak the words and sing the songs that seem to come from the moving figures on the stage. Altogether, nearly thirty people are required to give the puppets sound and motion.

The 300 stage settings are designed for rapid shifting. The transition from one background to another is accomplished while a few bars of music are played by the orchestra. When puppet crowds are

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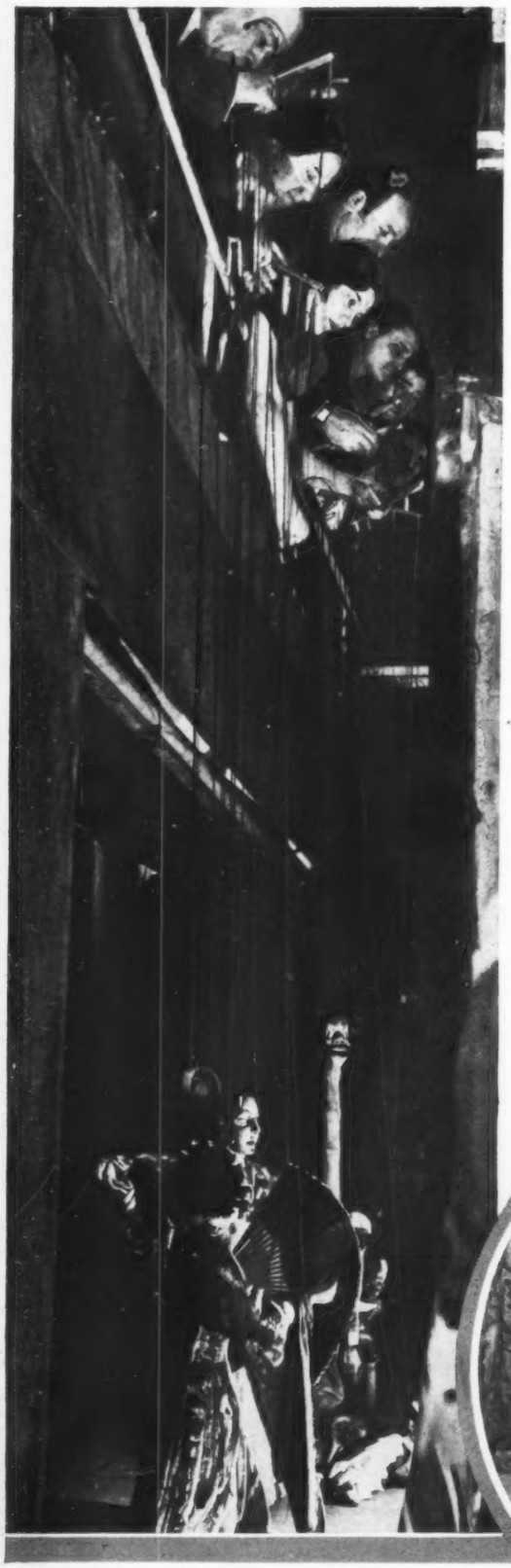

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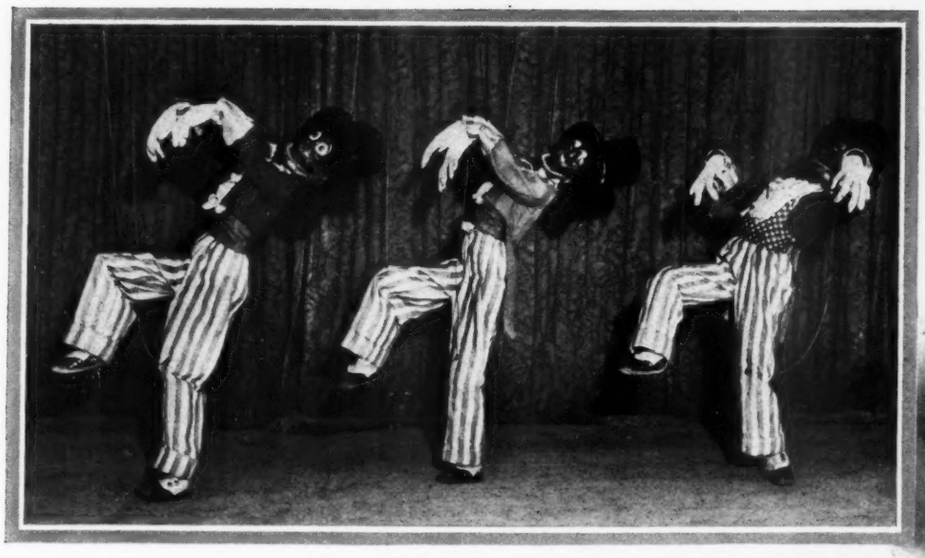

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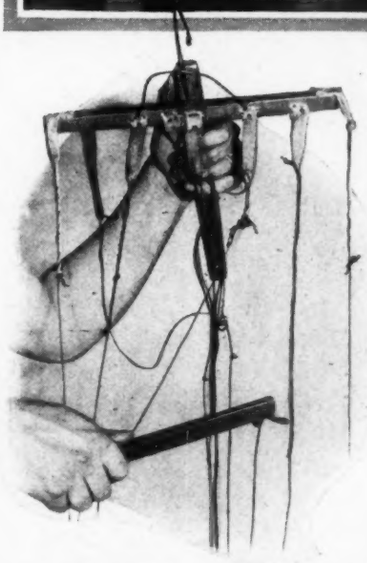

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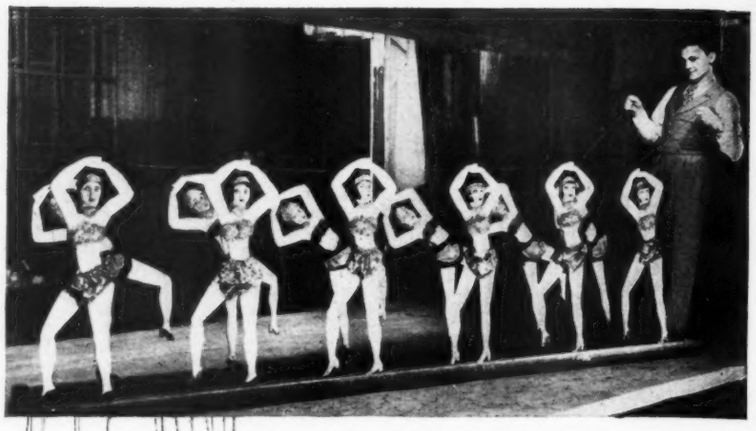
Using the hands and fingers to control a puppet requires years of training as every movement affects the tiny figure



One puppeteer, drawing with trained skill on the strings that govern these figures, can make all twelve dance. Many strings are needed to operate the two at the left

needed in a scene, special preparations are made. Rows of the little actors are hung in the wings. All of the operators except one climb to the top of the platform. Then, the one left below unhooks the puppets one after the other with catlike agility and swings them over to the stage at just the right moment.

Thus one figure after another moves out from the wings as the puppeteers above walk slowly along the platform to their proper places. Some of the marionettes are hung from hooks and in this way allowed to stand motionless in the background on the stage. But the majority are kept slightly in motion, swaying realistically or taking a step now and then, while the principals carry on the action of the play.

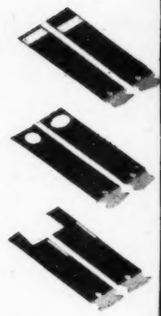
Perfect manipulation of the complicated equipment is needed to prevent tangling of the wires. Sometimes as much as two years are spent rehearsing a feature before it is incorporated in the show and presented to the public. One of the most famous scenes on the repertoire, which includes everything from grand opera to black-face comedy, demands almost as delicate handling of the wires as is required of a violinist fingering the strings of his instrument. It shows a pianist tossing his hair and hammering the keys as he accompanies a quartette of vocalists giving a song recital with appropriate gestures.

Each marionette is about four feet tall. The form of the body depends upon the part the puppet is to play. One has a solid trunk and unbending legs; another joints at the waist, shoulders, knees and ankles. Acrobats sometimes have arms and legs which, unseen by the audience, detach themselves and reattach themselves automatically to enable the wooden athletes to perform difficult contortions. The wires hooked to the various parts of the figures must be frequently adjusted to insure just the right tension.

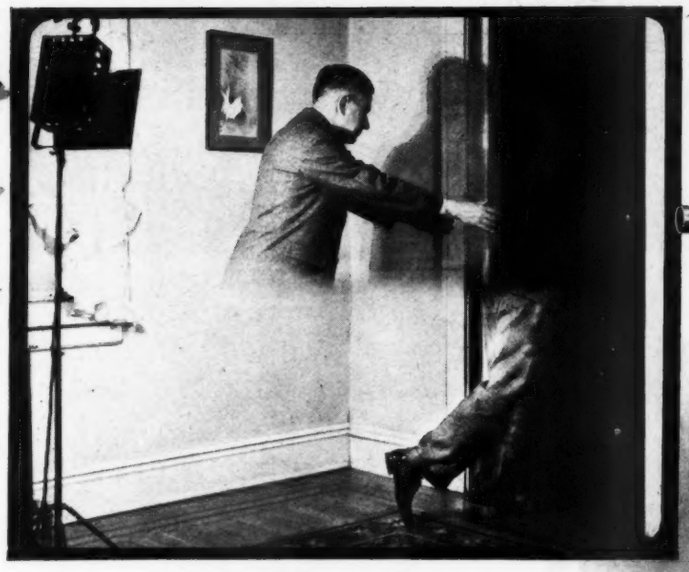
Expert sculptors carve the heads of the marionettes. Each puppet is given features to fit the rôle it plays in the performance and the faces are painted to give realistic expressions. Hinged jaws allow the mouths to open and close in synchronization with the words spoken by the invisible actors in the pit.

While most of the heads are carved from wood, some are made of plastic material and a few are built up of squares of silk pasted one on top of the other until the desired shape is achieved. To provide for emergencies, an elaborate "hospital" equipment *(Continued on page 95)*

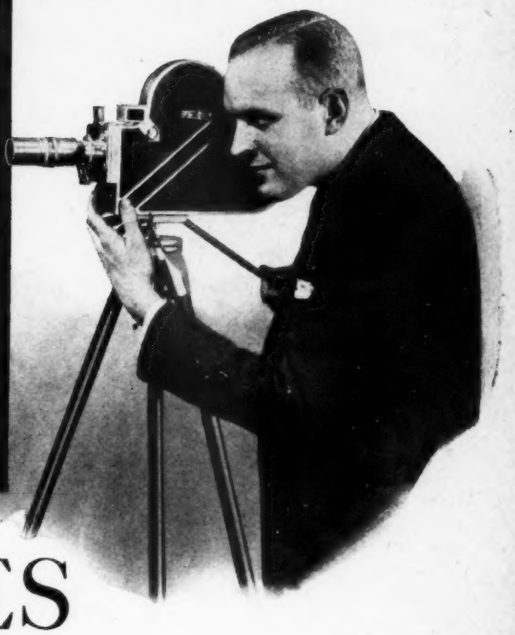
Dressed in the costumes they wear during a performance, these actors wait for their cues



These masks, above, which split film in new camera either vertically or horizontally, are used to make trick double exposure shots like the one at right



Below, the movie camera in action. In this picture a 200-foot film magazine is being used



FREAK MOVIES

Easy with New Amateur Camera

A NEW sixteen-millimeter movie camera now places the professional's bag of tricks in the hands of the amateur.

Fade-outs, double exposures, animations, and enlarged close-ups are only a few of the unusual shots that can be obtained merely by pressing buttons.

Besides lens turret and slow-motion shutter, this new product of the Eastman Kodak laboratories in Rochester, N. Y., has a number of other improvements not found on the ordinary high-grade home movie camera. A crank that runs the film through the camera backwards, an accurate, geared film footage indicator, a unique focusing device, and a shutter that can be opened or closed while the camera is operating are important features.

Lap dissolves, the professional trick of fading one scene into another, are accomplished by means of the simple back-cranking arrangement and special shutter. At the end of a scene, the footage indicator reading is noted and the shutter is closed slowly. Then, the film is back-cranked to the original reading of the indicator, the button pressed to start the filming of the next scene, and the shutter opened slowly. Thus, as the light from the first scene is diminished, the light from the second is increased, making the first scene dissolve slowly into the second.

Freak double-exposure stunts are made possible by tiny masks that slip into a slot at the front of the new camera. The masks come in pairs to split the picture in half either horizontally or vertically.

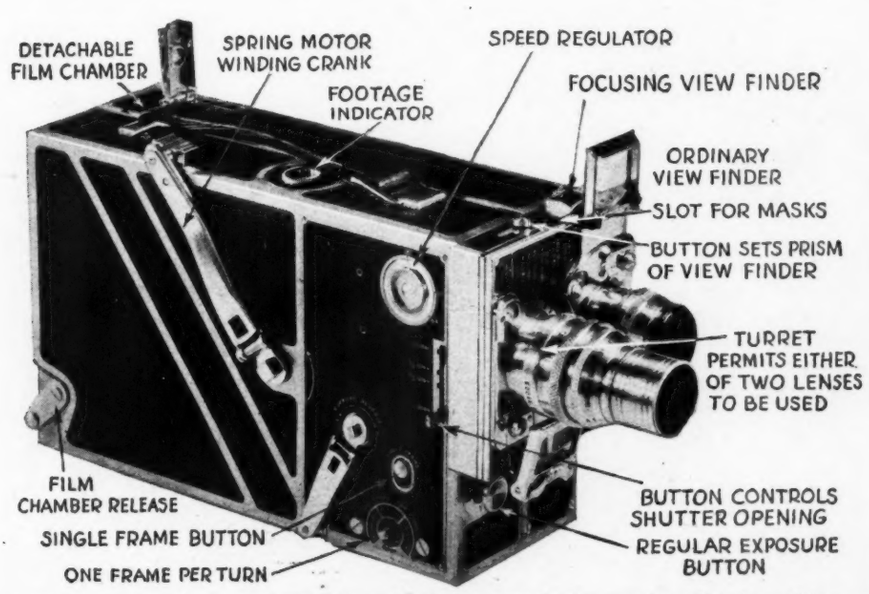
By using the vertical masks and manipulating the back crank and shutter, objects and human beings can be materialized realistically from thin air. Ghostly figures can be made to appear, spooks to solidify into real flesh-and-blood men, and the same man shown sitting in several chairs in the same room at the same time.

Dolls and other toys can be brought to life with the animator button on the camera. Each time the button is pressed, a single frame of the film is exposed. By moving the arms and legs of a doll a trifle between each exposure, life-like action can be obtained. When the row of single exposures is projected at the normal speed, the doll will walk, run, jump, or turn graceful somersaults.

A unique focusing device, consisting of a tiny prism that can be raised into place between the lens and the film, increases the accuracy of double exposures made with the new camera. This prism reflects upward against a ground glass mounted at the front of the camera under a magnifying glass the image formed by the lens. Anything that appears on the ground glass will be reproduced in the same position on the film even when the object is but a few inches from the lens. This makes accurate focusing simple.

As a safeguard, the reflecting prism is so arranged that it automatically drops back from its position between the lens and the film the moment the picture-taking button is pressed.

Although other amateur movie cameras have speed ranges that vary from eight to sixty-four frames a second, the new camera is so designed that the speed can be changed while taking the picture.

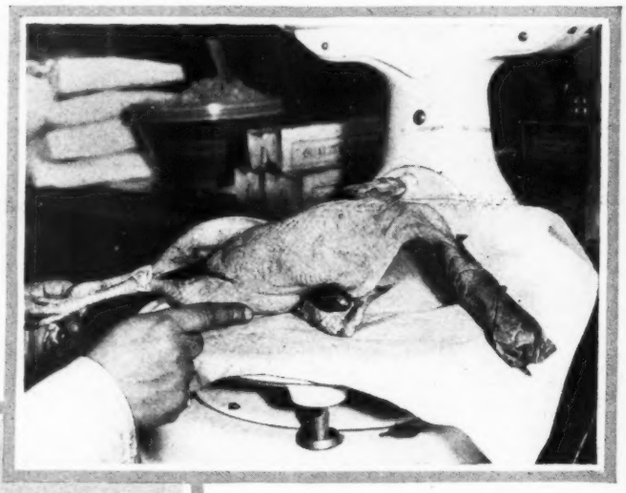


Here is the new movie camera for amateurs with the many special features that add to its usefulness

Gyps Can't Cheat

DISHONEST storekeepers are encouraged to use light weights and short measures by the indifference of their customers, according to Commissioner Joseph P. McKay, of New York City's Bureau of Weights and Measures. Doctored scales give short weight. Crimped-in berry baskets deceive the eye as to their contents. Gasoline pumps can be manipulated dishonestly. Easy prey to these practices is the careless buyer. Tricks of the gyps are exposed in the photographs on these pages, made especially for POPULAR SCIENCE MONTHLY with the cooperation of Commissioner McKay. All illustrate cases of fraud discovered by his staff—many crude, a few subtle enough to fool any but the Bureau's trained experts. One gyp, for example, installed a foot-pedal system worthy of a crooked gambling hall to control the weight registered on his scale. No one can estimate how many hundreds of housewives he cheated.

Here is a barrelful of the gyp scales seized by the inspectors of the New York City Bureau of Weights and Measures. Many of these scales passed inspection when purchased but then the dealers tampered with them. One crook put dirt in his scale to destroy its accuracy and fool the buyer

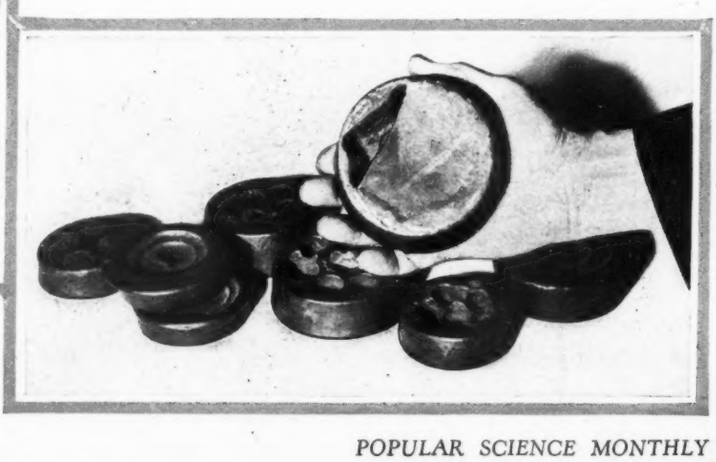


Loading poultry with lead sinkers to make them weigh more is a favorite gyp trick. The lead is hidden under the wing or in the oiled paper that covers the head. This crude form of fraud cheats many customers

At left is a crooked scale to which the dealer had hung a couple of nuts and two other pieces of metal which were concealed by the box that supported the scale. This trick should have been easy to discover but no one noticed it until found by an inspector

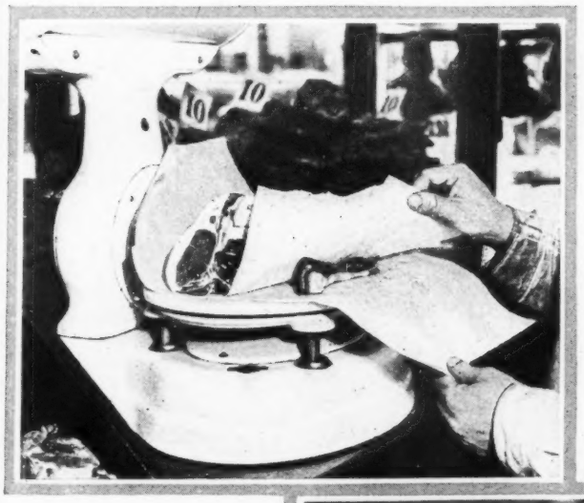
When you buy berries, watch the shape of the box. If the box is soaked in water, the wood becomes flexible and the sides or bottom are readily bent out of shape so that the box holds only a small portion of the berries you pay for

Scale weights may look all right on top but when the bottom is exposed large pieces of metal are found to have been gouged out as is shown below. Making the weights light so they weigh less than they are marked is a favorite form of fraud by the crooked dealers

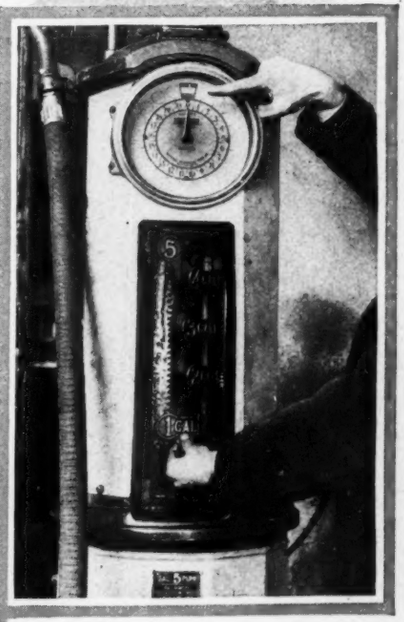


You... *If You Know These Tricks*

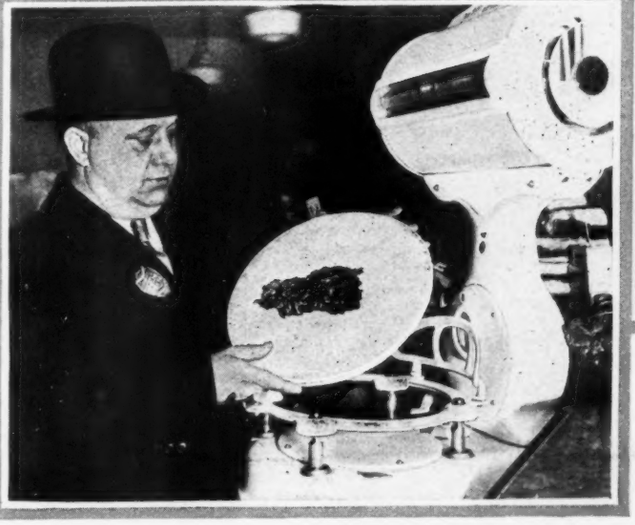
Measuring cans cannot always be trusted. These two cans were sent to the Bureau of Weights and Measures and were stamped accurate. Afterwards, their bottoms were removed and double walls and bottoms inserted. At the left, the double wall is seen and, at right, cutaway shows the nature of the interior construction



Here is illustrated an elaborate gyp trick. A wire was attached to the pan of the scale and ran down through a hole to the pedal beneath the counter. A four-ounce weight, fastened to the wire, normally lay in a box. Working the pedal lowered the box and added the four ounces to the weight of your purchase. This trick, found by an inspector, could not easily be detected by a customer



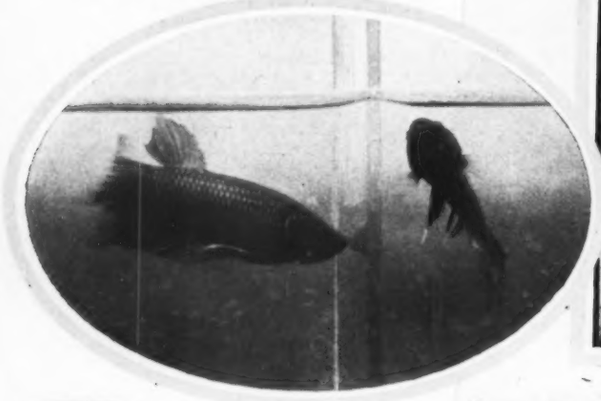
When the meat you have bought is placed on the scale, a hunk of salt pork is slipped between the two sheets of paper and its weight added to what you have purchased. The pork is removed before the meat is parcelled. This trick, done skillfully, will deceive you unless you are on guard

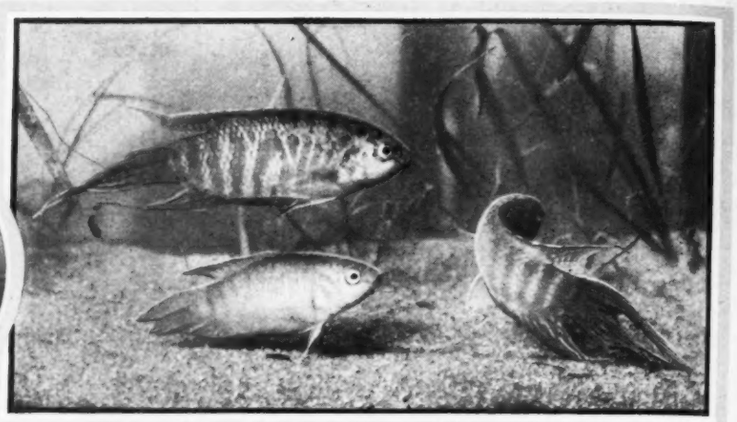


The gyp's trick at the right works even with the best modern scales. A handful of chopped beef is pressed against the bottom of the scale pan and remains there, adding its weight to that of the customer's meat. If caught, the crook says the extra meat got there by some unexplained accident

Some gasoline meters can be tampered with as is evidenced in the photo above. In this type pump, the flow of the gasoline can be controlled by levers inside the pump. If the dealer wishes to cheat, he pushes the one-gallon lever into position and leaves it there. The geared bar, then, will fall only to that point and the buyer is one gallon shy in five

Siamese fighting fish, below, are so fond of a scrap that a glass partition is put in the tank to keep them from killing each other





Raising Tropical Fish

NOW BIG HOME INDUSTRY

The ideal way to net fish is shown below. Two nets are used to avoid scaring or injuring the fish. At upper right, paradise fish, the first to be used as pets

SWIMMING rapidly in flashing arcs, are two tiny fish, not over two inches long. From their bodies of pinkish flesh color, dappled light is reflected as they twist about, weaving foamy trails, stirring the whole of their water world.

At intervals, the tiny tempest is stilled, and one fish remains poised, while before it, the other throws itself into a variety of poses, sometimes darting, jiggling, in a quaint sort of dance before the onlooking female. Finally, she finds the virtuosity of the male irresistible, and allows him to lead her to a corner of the aquarium.

Here he has prepared a nest. Laboriously, he has built it with a strange formation of cells under his gill covers, that enable him to blow tiny bubbles on top of the water. To prevent the bubbles from breaking, he coats each one with a glue-like substance from his mouth. Once the completed nest is floating on the surface like a minute honeycomb, the would-be father hastens to find a potential mother. Having drawn her near the nest by his dancing, he performs an amazing feat. Each egg she lays, he catches in his mouth and places in one of the bubbles.

When the eggs are safe in their floating bubble-nest, there is a startling, sudden change in the solicitous father-fish. He becomes a domestic tyrant, turning upon the mother-fish and driving her from the nest. The pursuit of courtship may become the pursuit of murder. The father-fish wishes no distraction from his task of guarding and nursing the eggs. Should one fall from the nest, he will rescue it, blow a new bubble, and replace it in the nest. The air in the bubbles will sustain the newly-hatched fry until they are able to go in search of their own food.

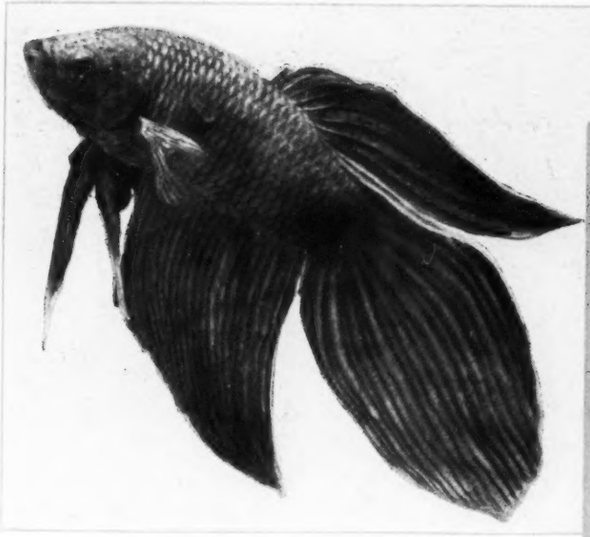
That is only one of the surprising things about one variety of the little fish that, in the last two years, have dethroned the sacred goldfish and created a new industry. The engaging creatures that have thus caught the popular interest are among the smallest things in the sea—the tiny tropical fish from the earth's warm waters.

In the last year probably $1,200,000 worth of them were brought into this country. In the last three months, one dealer sent 3,500 shipments. There are companies that do nothing but import and sell them. There are scores of clubs of tropical fish collectors. Stores have sprung up to sell nothing, and magazines to discuss nothing, but these fish and how to tend them. An amateur breeder of tropical fish, by selling part of his stock from time to time, can make his hobby self-supporting and even cause it to show a profit.

To most people a goldfish is a goldfish, bred from the lowly carp; but a tropical fish may be a guppy or a platy or a swordtail, or like the dancing fish of unique courtship and fatherhood, a labyrinth fish. He may be flesh-colored, or bright red, or green, or yellow. He may be striped or spotted. He may turn his colors on or off as environment dictates. The less versatile goldfish doesn't enjoy his bowl, can't breed in it, and soon dies. He is a cold-water fish. The tropical fish likes warm water, and in captivity, he breeds so rapidly that the family that starts with one aquarium may finish with a half dozen, without having bought a single additional fish. Tropical fish live in captivity from five to ten years.

And fun? Watch the Japanese medaka swimming about, looking for a place to hang its eggs. Yes, hang them, for it carries them like a cluster of grapes, dangling from underneath its neck. Hither and yon darts the microscopic, brightly colored little body. Finally it brushes against some marine plant and the eggs are detached and hung amid the foliage.

The labyrinth fish and the medaka are but two of the 300 known species of tropical fish suitable for pets. For many, life begins, not in the egg, but with live birth, as among mammals. Some West



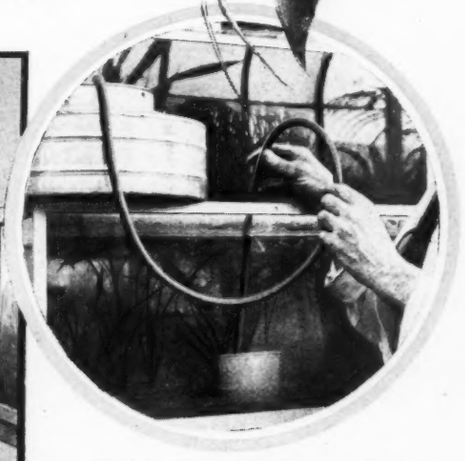
Artificial breeding of tropical fish has, in many cases, resulted in remarkable development as is seen in the luxuriant growth of fin and tail so noticeable in the specimen that is illustrated at the left

When the fish has been netted, as shown on the opposite page, it should be lightly grasped in the bottom of the net, which is then inverted and the fish gently pushed into the water. At left, a scalare, a silver-colored fish with fins enormously elongated into a grotesque suggestion of chin whiskers

How to get, feed, and care for tiny household pets from the warm seas, some of them fierce fighters, is told in detail in this article

By Thomas M. Johnson

John R. Chalmers, expert aquarist of Bassi Freres, New Rochelle, N. Y., is demonstrating the proper way to filter water out of an aquarium. Note, tube at the end of the hose draws the water from the bottom of the tank



In siphoning water into an aquarium, a bowl is placed in the bottom to avoid stirring up sand and vegetation

Indian mother-fish have in quick succession, six litters of from forty to fifty live babies. An African fish carries eggs and newly-hatched fry in its mouth. If badly scared, it swallows them. Even when they are large enough to venture forth, they will, if frightened, seek haven within its mouth.

So whoever joins the thousands who are installing in their homes aquariums for tropical fish will be interested, fascinated, and kept busy.

Before buying fish, you must have a place to put them. The aquarium, tank and stand, you can make according to directions already published in POPULAR SCIENCE MONTHLY, (P.S.M., June, '31, p. 116) or you can buy them at a special tropical fish store, a pet or animal shop, or a department store. Before filling the tank with water and putting fish in it, however, there are other things to consider and much to know.

Fish need water and space in which to swim, and they also need oxygen and food. To supply plenty of oxygen, the tank should be large enough to afford a good surface area of water; the rectangular tanks now sold are of the right proportions—the old-fashioned goldfish bowl is out of date. The oxygen will be replenished by absorption at the surface. Also, the carbon dioxide that forms in the water must be eliminated. Any of the graceful, fern-like water plants will do that for you, and you can get them where you get your fish.

Tropical fish need warm water. As they cannot stand extreme heat or cold, the temperature should be kept around seventy or eighty degrees. A thermometer and a lamp heater are good investments. You will need two little nets to remove objects or to move fish from one aquarium to another. Not long after they have begun swimming about their new, modern home, the stork will come. Some morning, you will wake to find your tank thronging like a beehive.

First, which kind of tropical fish do we choose to be the forefathers of this addition to our family? Here they are, in pet shop or department store; all sorts, shapes, and sizes, though none more than five inches long. Prices from $50 for very rare specimens, to 25 cents to $5 for the most popular ones. Some are floating quietly, but more are continually swimming about, for mostly they are active little fellows. Each has his special characteristics, his little tricks.

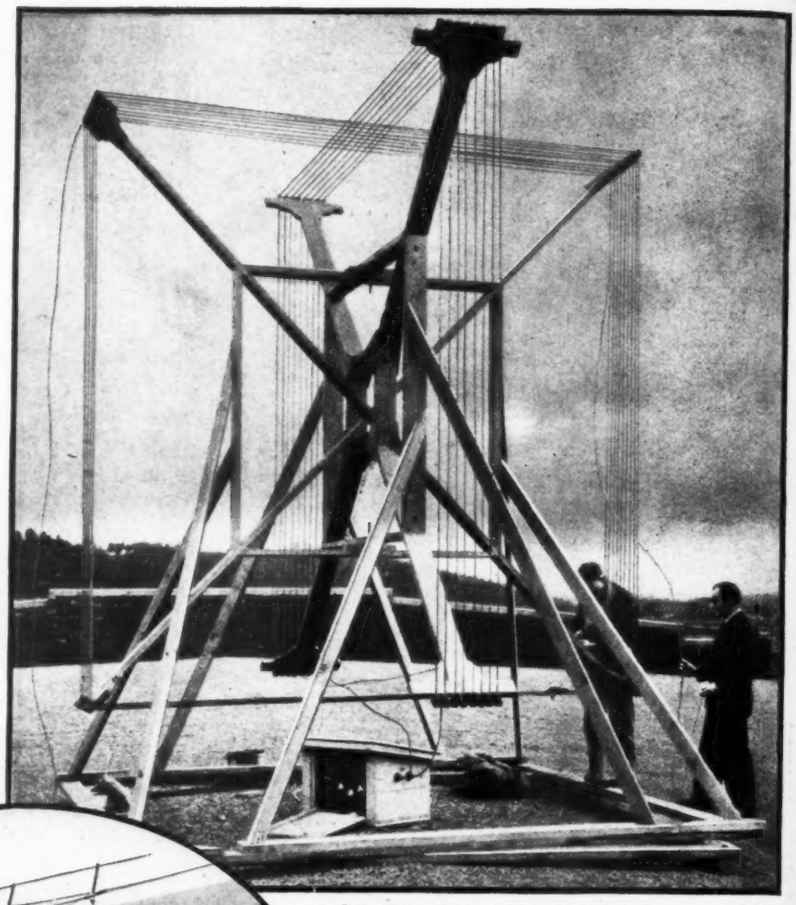
As for in- *(Continued on page 94)*

Curved Radio Beam Now Lands Planes in Fog

Fog blankets the Newark, N. J., terminus of the transcontinental air lanes. Through the gray curtain, so thick that men and objects twenty feet away are barely distinguishable, comes the roar of an airplane making port. It rises to a crescendo. Will the invisible machine crash? Suddenly the craft flashes out of the murk. It drops on the runway in a perfect three-point landing.

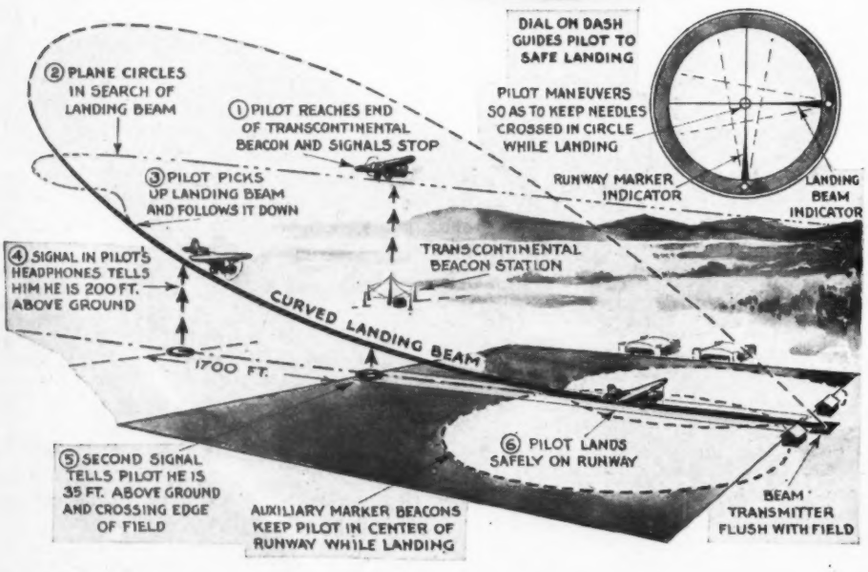
Such a blind landing only recently would have been fraught with the greatest peril. This pilot, however, knew his way to earth as well as if it had been marked with signposts. He was guided by radio's latest gift to aviation—a curved landing beam which, after two years of experimental work, has just been perfected and installed at the Newark Airport.

The new system picks up a fog-blinded pilot where the standard long-range radio beacon leaves off, providing the long-sought means of getting him safely to earth after his trip between cities. Its landing beam is a radio signal so projected that it is received at uniform intensity along a curved path, which coincides with the proper gliding path of an incoming plane. By watching a needle on an instrument board dial, which tells him whether he is too high or too low, the pilot can follow the beam down. Auxiliary signals, registered on the same dial, keep him in the center of the runway. In addition, the pilot hears two audible signals in his earphones, the first one telling him that he is nearing the field, and the second warning him to level off for a landing. In first tests of the new system, a pilot in a hooded cockpit repeatedly landed his plane.



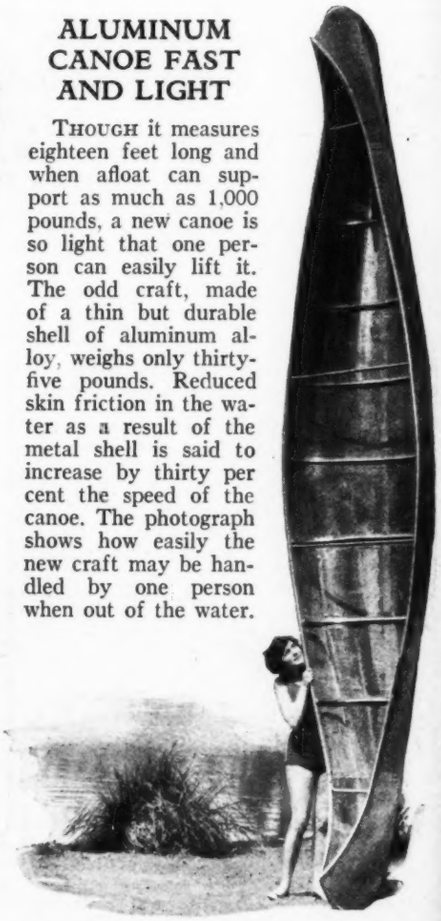
One of the odd-shaped radio aerials that are used in connection with the curved radio beam for airplanes

With the help of the new curved radio beam, the plane shown in oval landed blind at the Newark airport. Below, diagram makes clear the manner in which a plane is guided to an invisible field


DIAL ON DASH GUIDES PILOT TO SAFE LANDING
PILOT MANEUVERS SO AS TO KEEP NEEDLES CROSSED IN CIRCLE WHILE LANDING
RUNWAY MARKER INDICATOR
LANDING BEAM INDICATOR
② PLANE CIRCLES IN SEARCH OF LANDING BEAM
① PILOT REACHES END OF TRANSCONTINENTAL BEACON AND SIGNALS STOP
③ PILOT PICKS UP LANDING BEAM AND FOLLOWS IT DOWN
TRANSCONTINENTAL BEACON STATION
④ SIGNAL IN PILOT'S HEADPHONES TELLS HIM HE IS 200 FT. ABOVE GROUND
CURVED LANDING BEAM
1700 FT.
⑤ SECOND SIGNAL TELLS PILOT HE IS 35 FT. ABOVE GROUND AND CROSSING EDGE OF FIELD
⑥ PILOT LANDS SAFELY ON RUNWAY
AUXILIARY MARKER BEACONS KEEP PILOT IN CENTER OF RUNWAY WHILE LANDING
BEAM TRANSMITTER FLUSH WITH FIELD

ALUMINUM CANOE FAST AND LIGHT

Though it measures eighteen feet long and when afloat can support as much as 1,000 pounds, a new canoe is so light that one person can easily lift it. The odd craft, made of a thin but durable shell of aluminum alloy, weighs only thirty-five pounds. Reduced skin friction in the water as a result of the metal shell is said to increase by thirty per cent the speed of the canoe. The photograph shows how easily the new craft may be handled by one person when out of the water.



England's Most Famous Train Will Tour American Cities

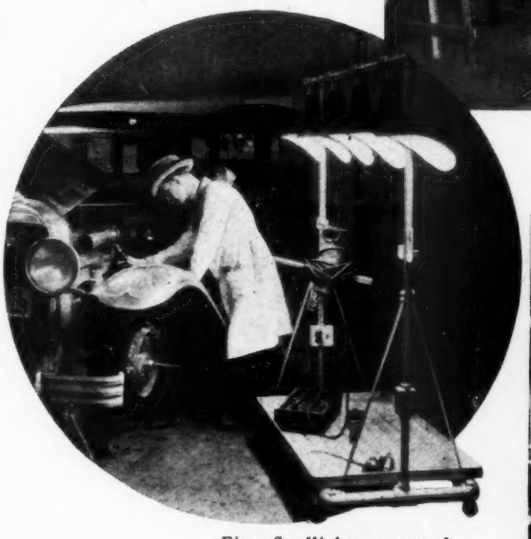
The Royal Scot, England's most famous train, will visit American cities this summer and then go to the World's Fair. It holds record for longest nonstop run

ACROSS America will soon roll the Royal Scot, one of England's most famous trains, resplendent with its deep red locomotive and cars. Transported across the Atlantic in its entirety, it was scheduled to start about May first under its own power on an exhibition tour of United States cities. Later it will visit the World's Fair. The train holds the record for the longest regular nonstop run.

Renovating and repairing one of the Royal Scot coaches preparatory to the visit to America and exhibition at World's Fair

GARAGE FLOODLIGHTS ON PORTABLE STAND

HANDY for the car owner who likes to tinker with his machine in the evening is a new portable lighting unit that throws illumination just where it is needed. Five floodlamps and reflectors are mounted on a stand, that can be rolled on casters to the work. The base of the stand is a convenient tray for tools and parts. Extra electrical outlets are provided for power tools.



Five floodlights, mounted on a portable stand, illuminate any part of garage for night work on your auto

EXPLODING LIQUIDS DRIVE ROCKET CAR

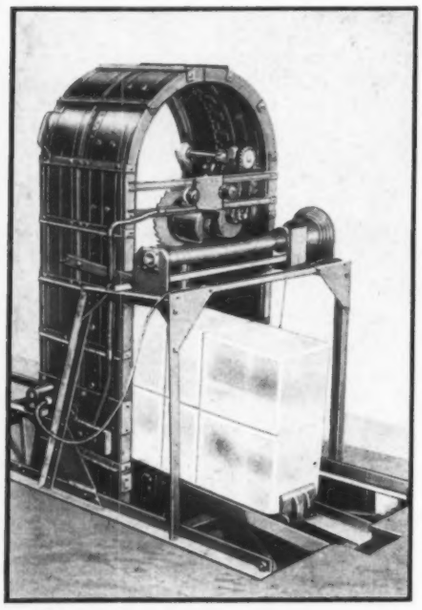
AUSTRIA now has a new type of the rocket automobile, built by Karl Cermy, Viennese mechanic. A mixture of combustible liquids and gases is fed into a wide cylindrical tube at the rear of the car, where it ignites with a continuous blast sufficiently powerful to drive the vehicle forward at remarkable speed. First trials are reported to have met with success. Aside from the unusual power plant, the controls are standard.

Combustible liquids, fed into the cylinder seen at rear of this new rocket car, ignite with a blast that propels the car forward. Built in Vienna, it is shown ready for trial run

CAR BATTERY FILLER HAS AUTOMATIC LIGHT

GROPING for the filler holes of a car's storage battery, when adding distilled water, is ended by a new self-lighting battery filler. When the nozzle is removed from its socket on the jar of water, a small lamp automatically flashes on and makes it easy to find the right place, as shown in the photograph above. Its concentrated beam also removes the danger of flooding the battery.

Moving Saw Cuts Accurate Grooves in Ice Cake



To INSURE accurate weight, a machine that seems almost to think, scores large blocks of ice so they can be cut accurately by the driver of the delivery wagon. The operator merely places the heavy cake of ice in the loop-like portion of the machine and an electric driving motor does the rest. All lifting and handling on the part of the operator is eliminated. The traveling saw moves around the ice block, while the block itself stands still. Automatic controls divide the block into spaces.

Above, the traveling saw moves around ice to score it crosswise, and at right, saw is tilted to score the ice lengthwise

HONE OF CURVED STEEL

MADE of rustless steel a new type of safety razor strop reconditions worn blades and improves the cutting qualities of new ones. Stroking the blade a few times on the highly polished curved surface restores the edge.

This reflector clamps to rim of auto wheel, catches headlight of approaching car, and clearly outlines car's left side

REFLECTORS LIGHT UP CAR WHEELS AT NIGHT

TINY reflectors, attached to the left-hand wheels of automobiles, form a new type of safety device for night driving. The reflectors pick up the light beam from oncoming headlights and create a brilliant circle of light around each tire. These mark the boundaries of the car and guide the approaching drivers. The reflectors are easily attached to the wheel rims and are expected to reduce the danger of cars side-swiping each other.

WIRE MOLDED IN QUAKE-PROOF BRICKS

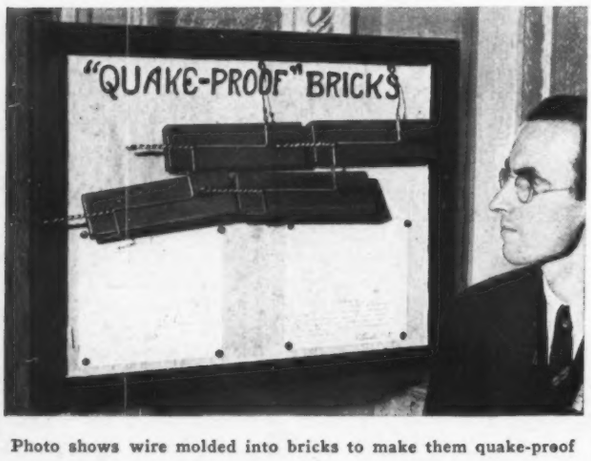
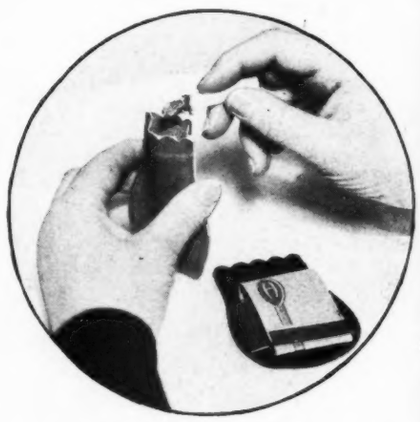


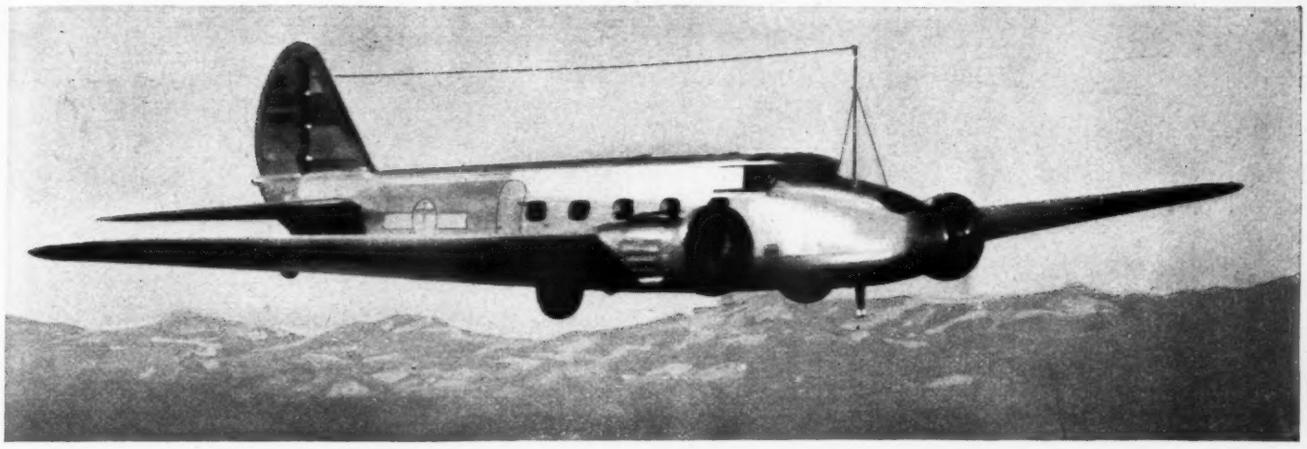
Photo shows wire molded into bricks to make them quake-proof

BRICKS that interlock are the builder's newest defense against earthquakes. A strong wire, molded into each brick, forms a long loop at one end of the brick, a shorter loop at the top, and a hook at the bottom. In laying the bricks, the long loop slides into a groove in the adjacent brick while the wire hook engages the loop on the top of the brick below. When mortar is pressed about the large loop, the brick is held in place so no ordinary quake will shake the walls down.



SMOKER'S ASH TRAY FITS VEST POCKET

A POCKET ash tray is the latest in smoker's accessories. Being only slightly larger than the pack of book matches which it also holds, this portable ash receptacle can be carried in the vest pocket. Pushing the two edges of the envelope-shaped tray opens it to receive ashes. When released, the mouth of the tray closes automatically and snuffs out any glowing sparks. Carried in vest pocket, it resembles a small card case.

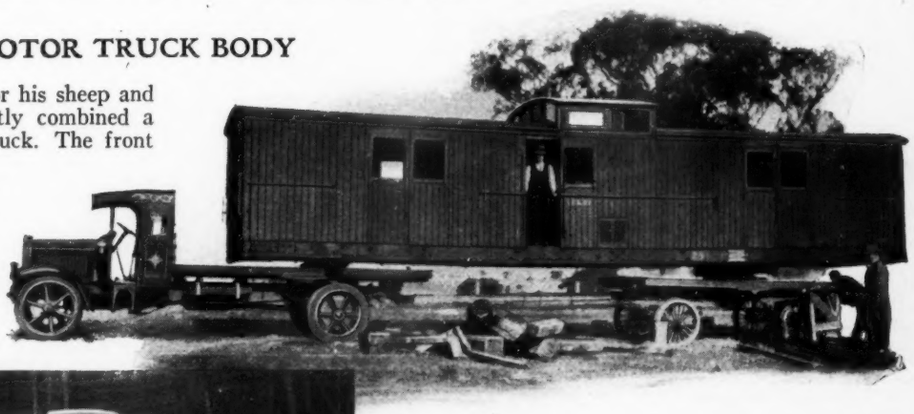


New Ten-Passenger Planes Fly 180 Miles an Hour

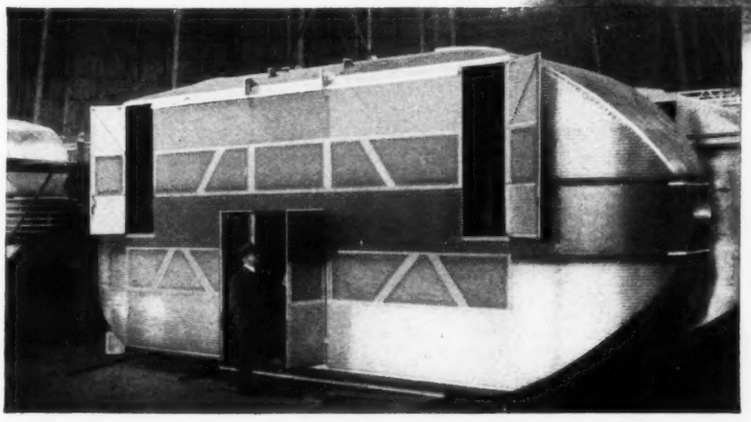
TWIN-ENGINED planes, having a speed of 180 miles an hour, are being put into service by the United Air Lines on the Pacific coast. These all-metal, low-winged monoplanes carry ten passengers, two pilots, a stewardess, 800 pounds of mail and express, and sufficient fuel to cruise 500 miles. Fully loaded, their cruising speed is forty miles an hour faster than the present average for multi-motored planes in the United States and may set new time records for commercial flights.

RAILWAY CAR IS MOTOR TRUCK BODY

NEEDING a large motor transport for his sheep and cattle, an Australian stockman recently combined a discarded railroad car and a motor truck. The front end of the car body was pivoted on the truck and the rear end was supported on a trailer. The inside of the converted railway car was divided into separate pens for the animals. The rigid construction of the railway car body made it well suited for the purpose of stock transportation.



This old railway freight car was adapted as a body for the motor truck and live stock hauled to market in it

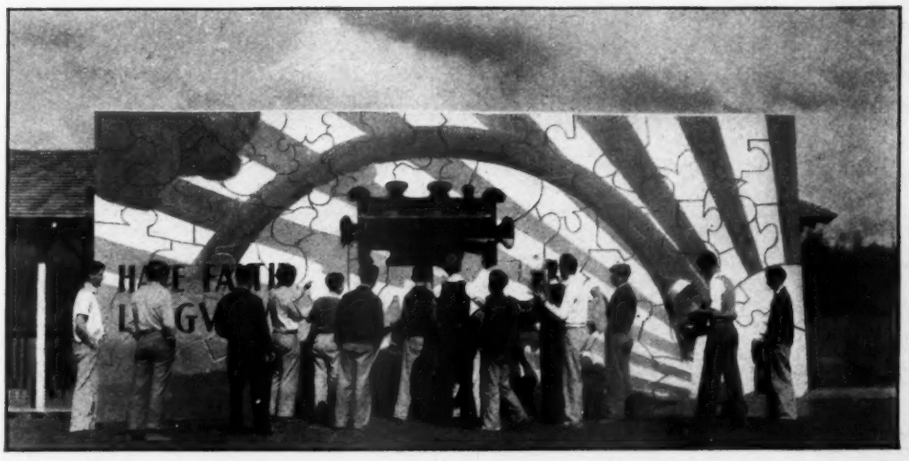


ROCKET CARS TO GIVE VIEW OF CHICAGO WORLD'S FAIR

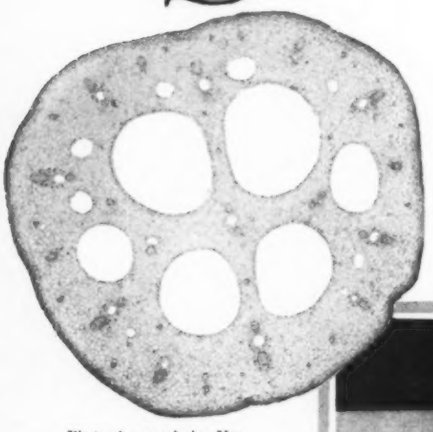
STREAMLINED cars, gliding along 2,000-foot cables, will thrill visitors to the Century of Progress Exposition to be held in Chicago this summer. Although resembling the rocket planes of the future, these bullet-shaped observation cars will travel at only five miles an hour. Although the cars are only 200 feet above the ground, the two towers supporting their cables will rise 600 feet. The cars, towed by these cables, spurt steam suggesting rocket power.

GIANT JIG-SAW PUZZLE IS 33 FEET IN LENGTH

STUDENTS at a high school in Longview, Wash., have just completed the largest jig-saw puzzle in the world. It contains 253 pieces and when assembled is more than twelve feet high and thirty-three feet long. Each individual piece measures more than three feet across. The subject of the giant puzzle is a colored picture representing the "Sun of Prosperity" with the "Rainbow of Accomplishment" circling the dome of the sky. The picture, painted on canvas, was glued to a large section of wood veneer. Photograph shows the students assembling their puzzle outdoors.



SECRETS of LIFE
revealed by your Microscope

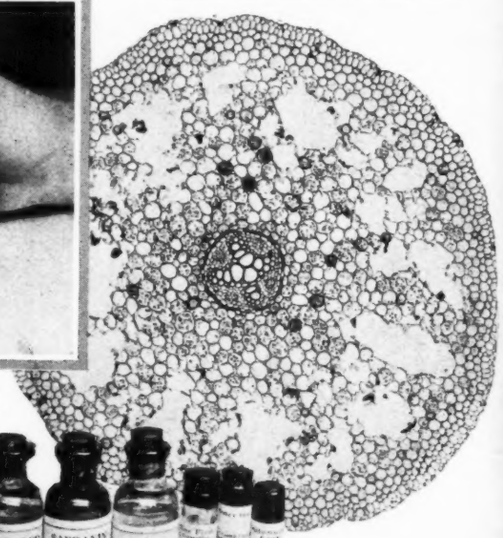


Photomicrograph by New York Biological Supply Co.

Cross section of pond lily stem, magnified nine times, from which a specimen can be cut

A quick way of staining specimens for immediate use is with a medicine dropper as shown. After the stain has soaked in, surplus around border is removed with blotter

Below, slice cut from the stem of a buttercup and magnified thirty times



Photomicrograph by New York Biological Supply Co.

This outfit contains stains, specimens, and special material. It can be bought for a few dollars

ALTHOUGH we have seen many wonderful things during our little journeys into the marvelous realm that lies beyond our sight, there is still much left to do, and a whole universe left to explore.

Even the little microscope we have been using, capable of magnifying only 300 diameters (that is, making objects appear 300 times their real size) opens a territory so vast that it would take us a hundred years to examine all of its strange details.

Hitherto we have been dealing with simple specimens that required little skill on our part. Now we are ready to take another and very important step. In the past, we were satisfied to study the surface of things, but henceforth we shall peer into their very insides. This new and exciting work will offer us a close-up of nature that can be obtained in no other way if we actually want to see it.

Let us take the opaque stem of a plant as an example. The real beauty of the stem is hidden from us, since to see it we must look inside where the cells are packed away and where the breath-taking craftsmanship of nature is on display. So what we shall need is a cross section of the stem cut so thin that light will pass through it. This we place under the microscope and see the real inside.

From certain specimens these thin slices may be cut with a new safety razor blade. To do this the specimen, gripped firmly between the thumb and index finger of the left hand, is held down on a piece of glass. Then with the razor blade in the other hand, a slice is cut off as thin as possible. Perhaps we shall have to cut a number of slices before we acquire the necessary skill; but if we are careful we shall be able to prepare some specimens in this crude way. In cutting, the blade is drawn across the stem, as a good barber uses a razor. Merely pressing down on the blade will crush the fibers and ruin the specimen.

To do this work more accurately and easily, we can build a handy little instrument that works very much as do the meat slicers in the butcher shops. It is called a microtome.

To make it, we need a piece of heavy brass tubing with at least a quarter-inch bore. The size of the bore will determine the diameter of the specimens that may be cut. In no case will a bore of more than one-half inch be needed.

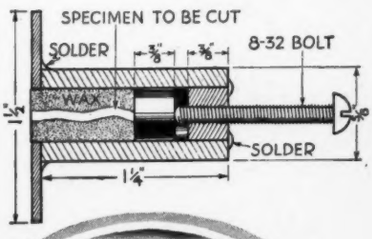
Into one end of the tube fit a brass plug and solder it in place. Through the center of this plug drill a hole with a No. 29 drill. Then with an 8-32 tap, turn threads in this hole and fit it with a brass screw.

The little table which is soldered to the opposite end of the tube is of sheet brass, heavy gage, and as flat as possible. A piece of brass rod that forms a sliding fit inside the tube completes this useful little instrument. With a good sharp razor blade at hand, your microtome is ready for use.

In using it, a specimen is placed inside the tube. As each slice is cut, the screw at the base of the instrument is turned slightly so the inside rod will push the specimen forward a tiny fraction of an inch. The cutting is done with the razor blade held close to the surface of the little table in the manner illustrated. By the proper manipulation of the screw, sections can be cut only a few thousandths of an inch in thickness.

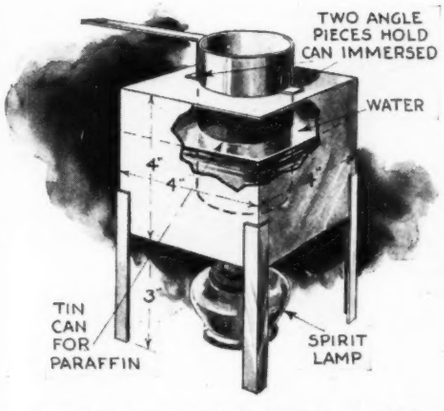
Merely to jam a specimen into the microtome in the manner described, however, would be the method of an amateur. The professional first puts wax around his specimen so that, while the cutting is being done, it will not be damaged by pressure or squeezing. The delicate stem of an iris, for instance, could not be cut without first embedding it in wax. Indeed, every biological specimen is thus prepared.

At left, the proper manner of cutting slices from a specimen with the microtome is illustrated. Below, line drawing shows how to make a microtome and, in circle, photo of completed microtome with adjusting screw in place



How Specimens of Living Things Are Cut into Thin Slices with Microtome, Mounted on Glass Slide, and Then Stained Is Told Here in Detail

By
BORDEN HALL



Drawing shows how to build heater in which the paraffin is melted without raising its temperature so high it will damage specimen

After the specimen has been mounted in place by pouring melted paraffin around it, the portion protruding from the end of the brass tube is cut off flush with the table. Then the screw at the bottom of the tube is given a small fraction of a turn and another cut is made. The first cut was simply to level off the end while the second cut provides the specimen. However, if you obtain a perfect slice on the second cut, you will be lucky. Generally, you will find it necessary to make several cuts before you are able to make really thin slices.

After skill is developed at this work and nice, thin slices are made, they may be slipped onto a glass slide and brought to the stage of the microscope without actually touching them with your hands.

Another point to be borne in mind in this work is that the paraffin used must not be too hot. If it is, it will tend to boil the water in the cells of delicate specimens and destroy their beauty. To overcome this, we build the paraffin heater shown in the drawing. The use of this little device will prevent the paraffin from heating above the boiling point of water and it will also be good insurance against fires. Also this pot will keep the paraffin warm for a long period of time. In preparing a specimen, it is dipped into the molten wax before it is placed in the microtome and embedded. An alcohol burner keeps the wafer hot under the wax.

Unfortunately some specimens require further preparation before they are ready for the little meat slicer. Thick, woody sections must be soaked for several days in clean water to make them pliable. When the sections are being cut, it is advisable to dip the edge of the razor in alcohol. Of course, if stems containing resinous matter are used, the soaking will be of little help as resin is not soluble in water. In such cases, we leave the specimen in alcohol for a day or two to dissolve the resin. Then it is placed in water for three more days. In a few cases, it will be necessary to boil the stems in water. In the case of material like the branch of a tree, this process softens the fiber and makes the cutting of specimen slices much easier.

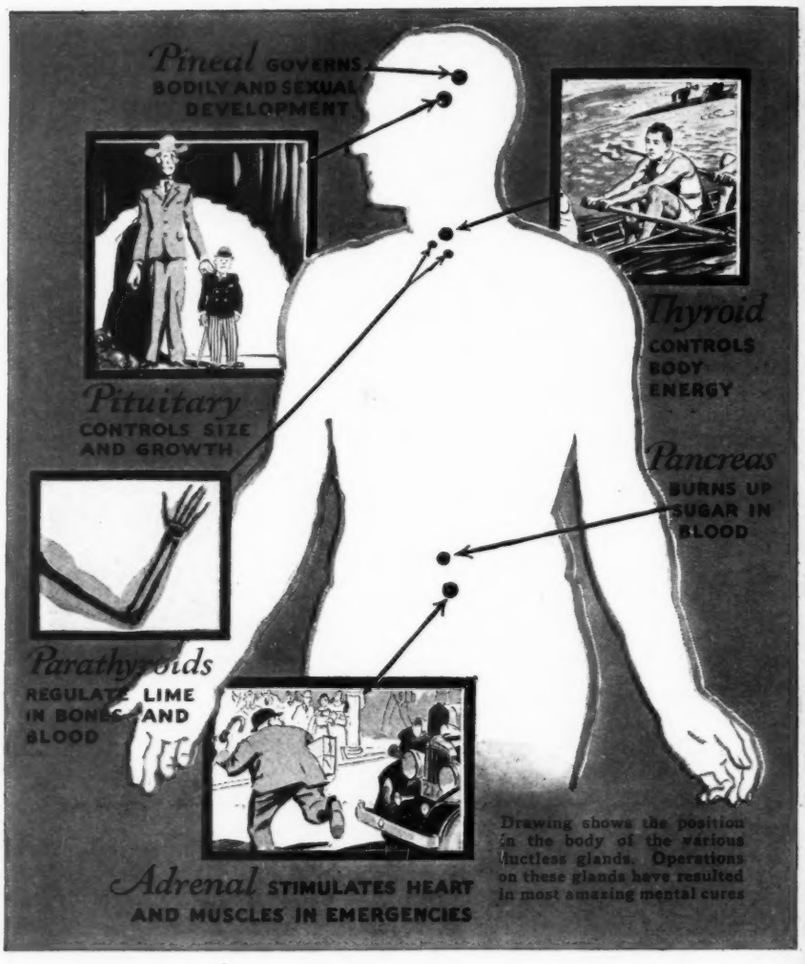
As we become skillful in the preparation of specimens, we shall eventually make slices so thin and so nearly transparent, that there will be little left to look at. Hence it becomes necessary to learn how to stain our specimen. A crude analogy will help us understand the reason for using stains. Under certain conditions of light, we are unable to see a piece of glass, a fact that is made use of by magicians in preparing stage illusions. However, if the glass were colored, we should not be so easily fooled. We use stains for the purpose of seeing and to reveal details of structure that would otherwise be invisible.

The kind of specimens we are considering at the moment, however, must be bleached before the stain is applied. This is done by dissolving one ounce of chloride of lime in ten ounces of water. A second solution is made with two ounces of washing soda dissolved in water. The two solutions are then poured together and thoroughly shaken. After standing for a day or two, the solution is filtered and put in well corked bottles.

To bleach a specimen, it is immersed in the bleaching solution for a period of several hours. In removing it, remember the soaking has made it fragile and care must be taken not to crush it. Once out of the bleach, it is necessary to wash the specimen in several changes of water.

The stains to be used should be obtained from a biological supply house. Although the amateur has a large number of them to choose from, perhaps none is better for the beginner than hæmatoxylin, a red stain prepared from logwood. In using it, a watch glass *(Continued on page 84)*

DARING
Gland Operations
Effect Marvelous Cures


Pineal GOVERNS BODILY AND SEXUAL DEVELOPMENT
Thyroid CONTROLS BODY ENERGY
Pituitary CONTROLS SIZE AND GROWTH
Pancreas BURNS UP SUGAR IN BLOOD
Parathyroids REGULATE LIME IN BONES AND BLOOD
Adrenal STIMULATES HEART AND MUSCLES IN EMERGENCIES
Drawing shows the position in the body of the various ductless glands. Operations on these glands have resulted in most amazing mental cures

THRILLING feats of surgery, undreamed of a generation ago, mark the work of the modern gland specialist. Personalities are altered, features are changed, growth is controlled, maniacs are restored to reason through delicate operations performed upon these mysterious chemical factories which are constantly active in the human system.

Gland surgery, today, is a realm of bewildering possibilities. Here and there in the present records, we catch glimpses of the wonders that may lie ahead.

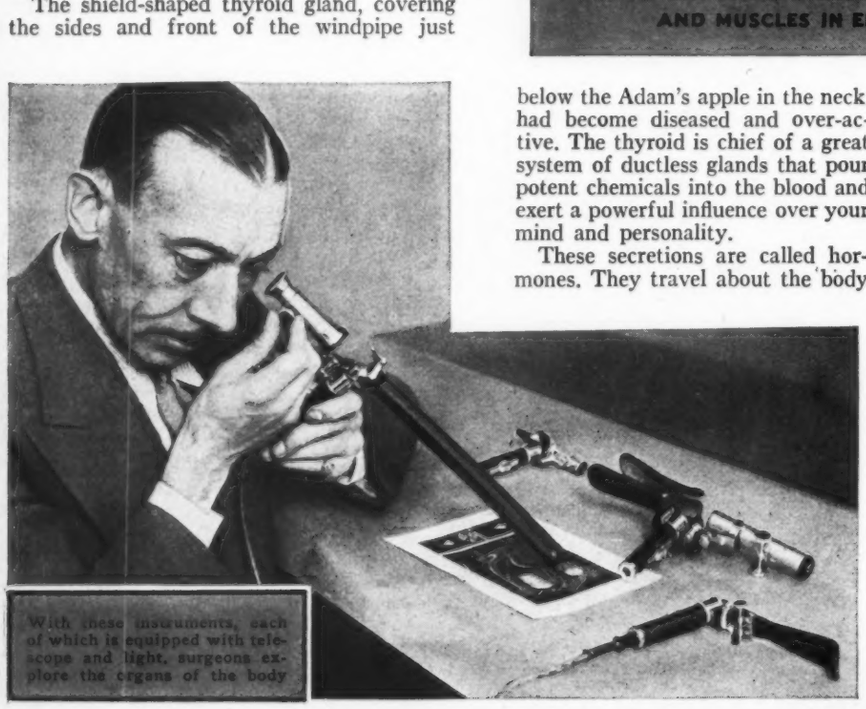
Witness a dramatic instance reported only a few weeks ago from Cincinnati, Ohio. A young man became alarmingly nervous. His weight dropped rapidly from 140 pounds to sixty-nine pounds. His eyes bulged from his head with a terrified expression and every muscle in his body constantly quivered. In a few months, he had become a raving maniac, kept in a strait-jacket to prevent his killing himself or injuring others.

The shield-shaped thyroid gland, covering the sides and front of the windpipe just below the Adam's apple in the neck, had become diseased and over-active. The thyroid is chief of a great system of ductless glands that pour potent chemicals into the blood and exert a powerful influence over your mind and personality.

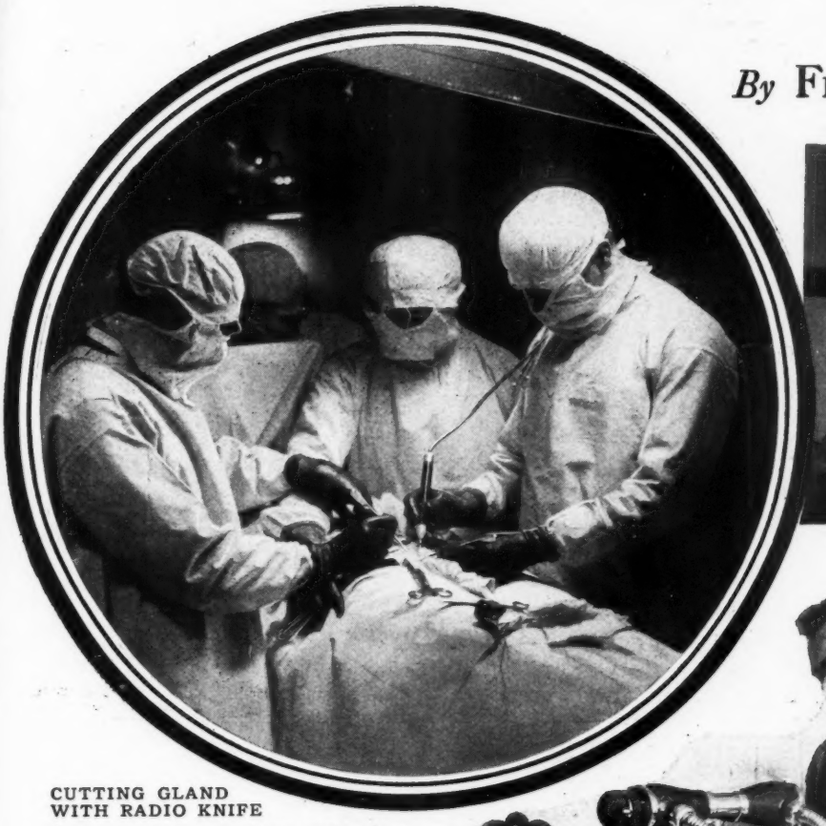
These secretions are called hormones. They travel about the body like chemical messengers governing the action of distant organs. The thyroid regulates the life processes of the body just as a damper controls the heat of a furnace. A diseased, over-active thyroid is like an open damper. It burns up the body energy faster than it can be replaced by food and oxygen.

This is what had happened in the case of the young man in Cincinnati. His one chance of recovery lay in a delicate operation which would remove most of the thyroid but leave just enough to keep the body functioning at normal speed. In the operating room of his clinic, the noted Cincinnati surgeon, Dr. Joseph L. De Courcy, performed this ticklish bit of human repair work with amazing results. In a few days, the patient became calm. Then, the mental derangement disappeared completely and, only a few months later, the young man had regained his weight and was able to resume his regular daily work.

Up to a few years ago, operations upon the thyroid gland were accompanied by considerable loss of blood because this


With these instruments, each of which is equipped with telescope and light, surgeons explore the organs of the body

By FREDERIC DAMRAU, M. D.



CUTTING GLAND WITH RADIO KNIFE

German surgeons are shown performing a gland operation with a radio knife which sears tissue and thus prevents hemorrhage

Pictures, left and below, show the facial changes that were caused by a disorder of the pituitary gland, the work of which was upset by a tumor

Portable X-ray machine used in making pictures of patients too sick to leave their beds

organ is richly supplied with arteries and veins. Recently, however, surgeons have been using the "radio knife," an electrified needle that sears the blood vessels as it severs them and thus prevents hemorrhage. These high-frequency electric knives cut tissue at a touch. They also cauterize it, killing germs and preventing infections.

When the thyroid is under-active, the results are almost as disastrous as when it is over-active. The mind slows down until the person becomes practically an imbecile. It has been calculated that three and a half grains a day of the thyroid chemical, thyroxin, is all that stands between intelligence and imbecility!

I remember one case of a child born with an inactive thyroid. Eyes closed and mouth open, driveling saliva, she remained speechless until the age of four. Her parents feared she was doomed to be an idiot. Then, small amounts of the dried thyroid glands of sheep were added to her meals. The effect was miraculous. She brightened up immediately, began to take an interest in play, and was soon talking like other children. In school, she passed her studies easily and is now an intelligent young woman. However, she will always have to continue the treatment. For, she tells me, on occasions when she has tried to do without the dried sheep gland, she has felt her mind becoming dull.

I know an elderly woman, who ten years ago, was literally snatched from death by a physician who diagnosed her trouble as thyroid deficiency. Treatment with thyroxin has made her stronger mentally and physically than she was in her youth.

The chief chemical element in thyroxin, analysis has shown, is iodine. When food or drinking water contains insufficient iodine, thyroid trouble and goiter are likely to develop. This condition is found most frequently in inland communities where fish and other sea-food, the chief food sources of iodine, are hard to obtain. Iodine is three times more abundant in codfish, for example, than in human beings.

Puppies from the same litter. From one at right pituitary gland has been removed to check its growth. The other grew normally

Travelers in the Italian Alps describe a queer people dwelling in the mountain village of Cogne. They are all undersized, dull, and apathetic. Many of them have goiter. Their water supply comes from the melted snow of the mountain tops and it contains no iodine. Recently, iodized salt and other forms of iodine which can be assimilated by the system are being given people in such communities.

Overcoming irregularities of the thyroid forms only a small part of the work done by the modern gland surgeon. Other phases of his activity are equally strange and dramatic.

Take the operations performed upon the tiny parathyroid glands, minute organs no larger than buckshot. Usually four in number, two on either side of the windpipe, they are so effectively hidden by the thyroid that nobody noticed their existence until 1880. In some mysterious way,

they control the amount of lime in our bones. When these glands become too active, our bones become soft; when they are not active enough, the bones become too brittle.

A few years ago, a sailor was brought to the Massachusetts General Hospital, in Boston, suffering from a puzzling malady. In eight years, he had grown seven inches shorter!

Six feet one inch tall in 1918, he was only five feet six inches tall in 1926. He had suffered seven fractures from inconsequential falls and had become so weak he had been obliged to give up his work as a master mariner.

Dr. Edward P. Richardson made an X-ray examination. The pictures showed that the patient's bones were abnormally thin and had lost their lime in many places. His parathyroid glands were overactive. Dr. Richardson removed two of the four organs and the trouble disappeared. The man was able to return to his work and later X-rays revealed that the bones had gained a healthy lime deposit. Although he suffered two bad falls subsequently, he had no further fractures.

Often, when very old people fall and break bones, the opposite is really true. A weakened bone snaps and they fall as a result. Middle-aged people and even children are sometimes brittle-boned because of defective functioning of the parathyroids. In Illinois, recently, a man troubled in this way sneezed and snapped a rib, and a few weeks ago, a seven-year-old boy was taken to a Madison, Wisc., hospital for treatment after he had broken

A frozen block of catgut as it is received in a hospital before being made ready for surgical use. In this form, it cannot lose its strength

bones twenty-seven times. Every time he fell or bumped into anything, a bone would snap.

In surgical treatment of the parathyroids, extreme care is necessary. Many of the functions of these minute organs are still unfathomed. But it is known that if all of them are destroyed, death results within forty-eight hours accompanied by muscular contractions of the jaws resembling the effects of tetanus.

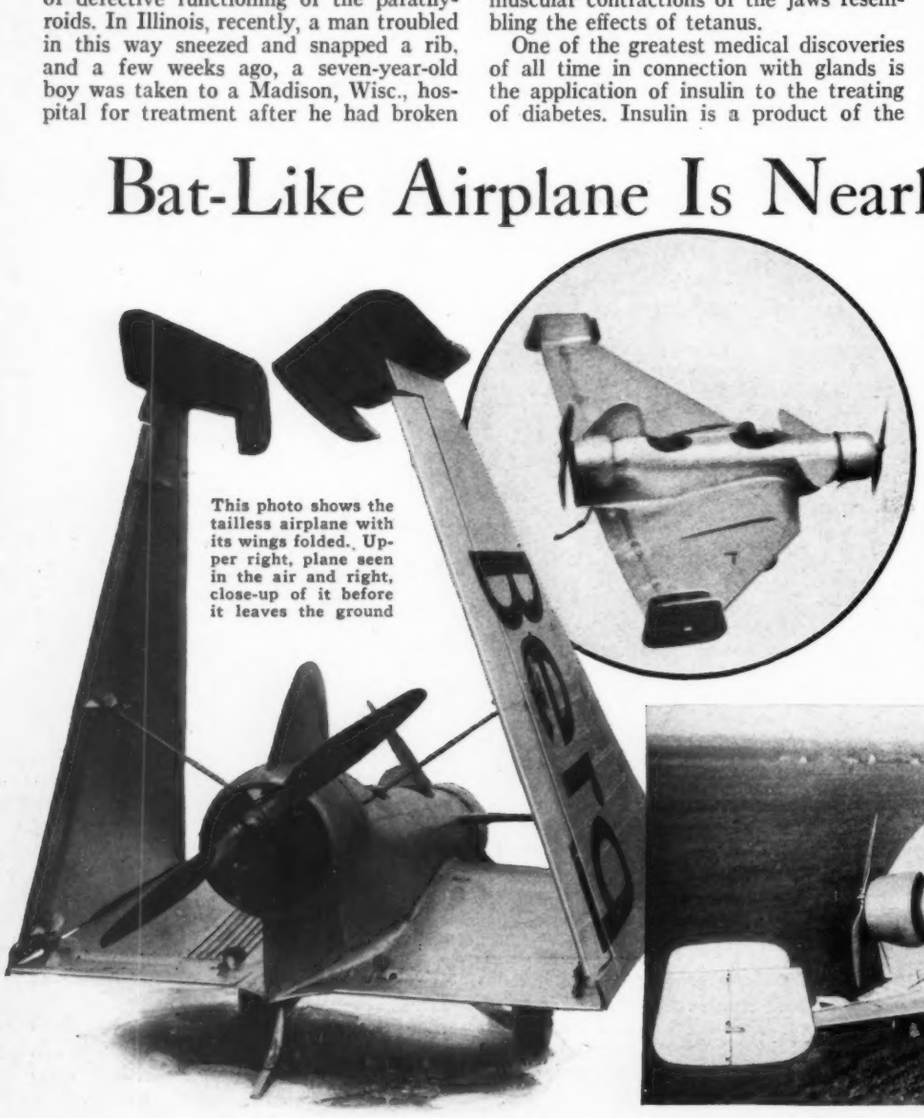
One of the greatest medical discoveries of all time in connection with glands is the application of insulin to the treating of diabetes. Insulin is a product of the pancreas, a large gland lying behind the stomach. It acts upon the sugar contained in the blood, enabling the body to burn it up and convert it into energy. When the pancreas fails to secrete sufficient insulin, sugar accumulates in the blood and diabetes results.

More than a million sufferers in the United States alone are being aided by insulin obtained from the fresh pancreas glands of animals and injected daily through a hypodermic needle to supplement the lowered insulin output of their own systems.

But this life-saving discovery marks only the beginning of the gland specialist's attack upon diabetes. In Chicago, Ill., not long ago, Dr. George De Takats performed a dramatic operation which may lead to conquering diabetes by surgery.

Making an incision in the abdominal wall of a diabetic patient, he pushed the stomach aside and reached the pancreas. Around a portion of this organ, he tied tightly a strip of living membrane taken from the patient's thigh. This constricting loop caused a part of the gland which secretes gastric juices into the small intestines to waste away. Correspondingly, the portion which manufactures the hormone, insulin, grew more active. In this way, the pancreas was stimulated to manufacture its own insulin and reduce the seriousness of the disease. Upon his recovery, the patient found he could eat a far more liberal diet and was able to reduce the amount of insulin taken hypodermically to smaller and smaller doses. In other parts of the *(Continued on page 96)*

Bat-Like Airplane Is Nearly All Wing



This photo shows the tailless airplane with its wings folded. Upper right, plane seen in the air and right, close-up of it before it leaves the ground

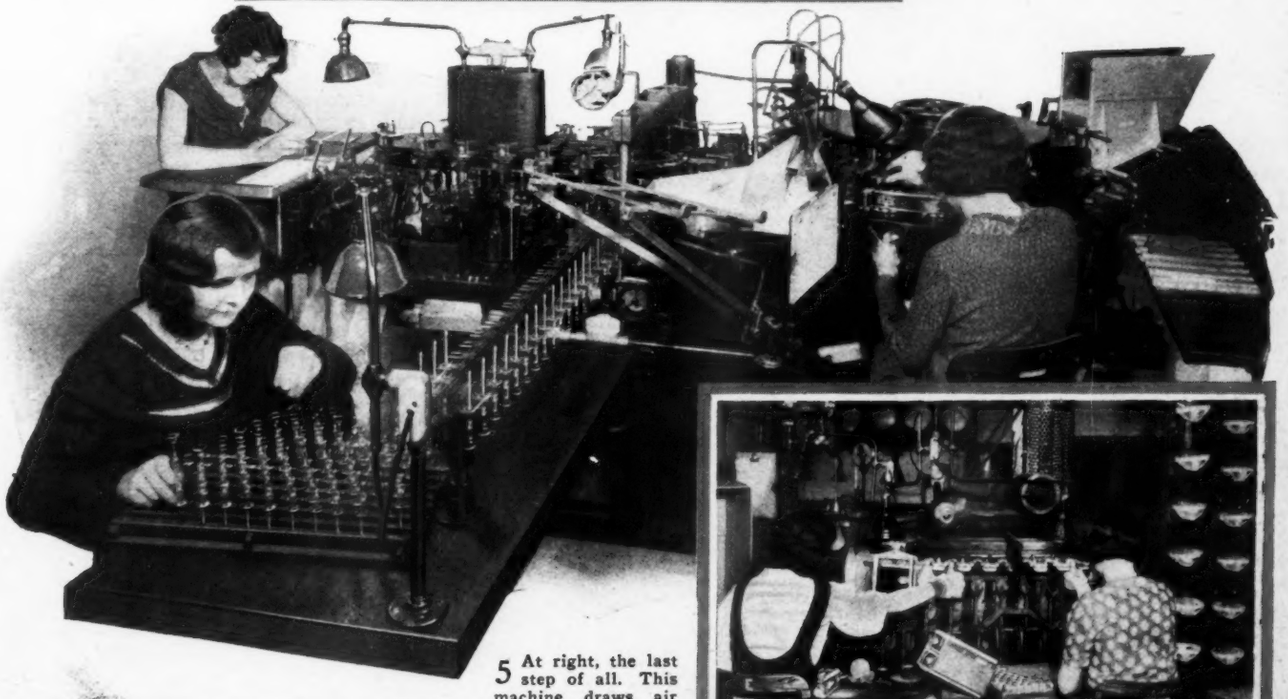
A YOUNG German inventor, Gerhard Fieseler, has startled the aeronautical world by building and flying a bat-like airplane that departs radically from conventional lines. His tailless machine is virtually all wing, a design for which he claims unusual stability. Its wings fold up, so it occupies little space in a hangar. The machine used by Fieseler in a recent demonstration is a two-seater sport model. Two motors, either of which is sufficient to propel the craft, are mounted in tandem. According to the inventor, the plane attains a speed of 160 miles an hour with a power plant of 150 horsepower. It is reported to land at a forty-mile-an-hour speed. In a climbing test the new airplane rose 3,000 feet in three minutes.

How Light Bulbs Are Made

1 Pictures on this page show the steps in the process of making electric light bulbs. First, the tungsten wire filament is drawn through diamond dies. So fine is this wire, one-quarter the diameter of a hair, that it is extremely difficult to see it

2 Here is the mechanical spider that takes the fine tungsten wire and winds it around a steel wire form to shape the filament. An attendant watches the process through a microscope to be sure the spacing is accurate

3 Tungsten coil and steel core then are cut into accurate lengths and the pieces placed in an acid bath which dissolves the core and cleans the filament. Afterward, the coils go to the projector, right, and their enlarged images are inspected in a search for imperfect coils

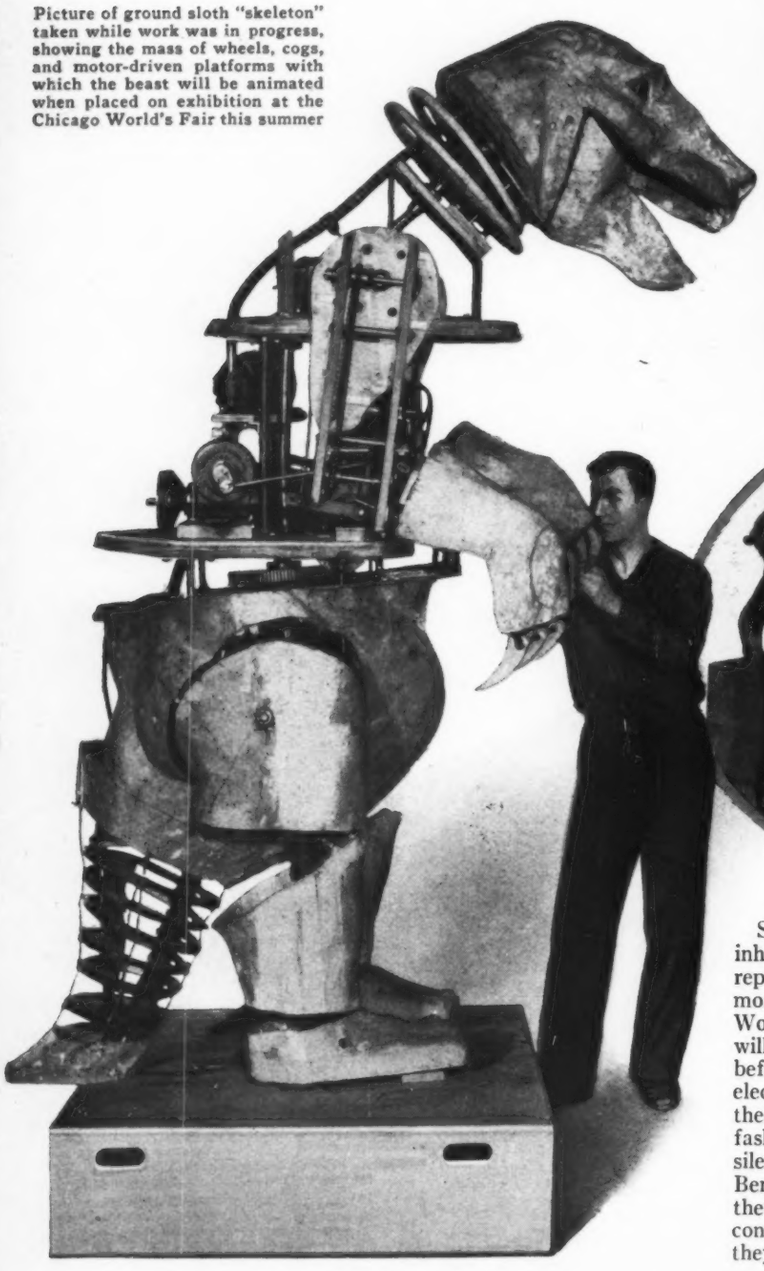


4 This elaborate machine puts the glass mounting stem in the bulb, while mechanical fingers insert the lead wires, put the filament-supporting grill in place, and hook the filament coil in the exact position necessary to give the best and longest lasting service

5 At right, the last step of all. This machine draws air from the bulb, seals the top, and solders the screw base in place, thus finishing the lamp for packing

Hidden Motors Give Life to Prehistoric Monsters

Picture of ground sloth "skeleton" taken while work was in progress, showing the mass of wheels, cogs, and motor-driven platforms with which the beast will be animated when placed on exhibition at the Chicago World's Fair this summer



A jungle scene forming a background for the animated prehistoric monsters. Note how the dinosaur towers above the elephant

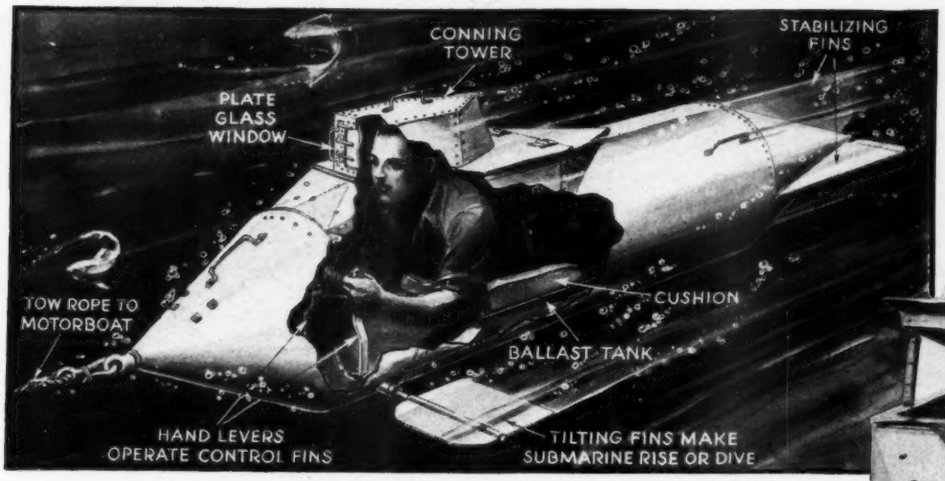
At left, a realistic covering is being put on the form of a saber-toothed tiger, another of the extinct animals that will be shown at Chicago Fair

SABER-TOOTHED tigers, giant ground sloths, and dinosaurs, inhabitants of the earth millions of years ago, have been reproduced mechanically by the New York firm of Messmore and Damon for exhibition this summer at the Chicago World's Fair. Within a huge hemisphere of metal, they will give visitors a glimpse of the world as it was long before man appeared. (P.S.M., June '32, p. 16.) Controlled electrically, the mechanical monsters swing their heads, roll their eyes, breathe, snarl, roar, and grunt in realistic fashion. A complicated mass of cogs, wheels, bellows, and silent motors produces the life-like sounds and motions. Beneath the canvas and papier-maché hide of each animal there are from one to sixteen electric motors. An operator controls the actions of the exhibits. At the World's Fair, they will be seen in an environment of prehistoric vegetation.

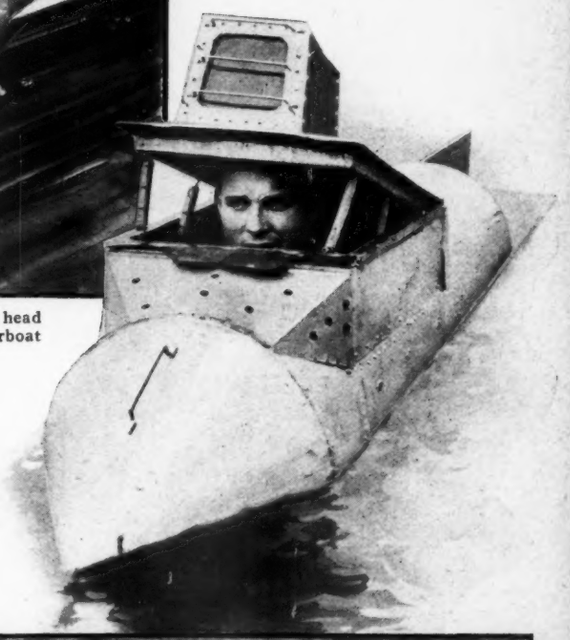
SECRET OF SPONTANEOUS HAY FIRES IS SOUGHT

SEEKING to solve the mysteries of spontaneous combustion, the U. S. Department of Agriculture is using a special core drill, shown at the right, and twenty-seven electric thermometers to keep constant tab on temperature changes in an experimental haymow at Beltsville, Md. Samples of the hay are taken with the hollow, motor-driven drill, and twice a day the temperature of the hay, at twenty-seven different points, is taken with the thermometers. Records of the heat developed by hay under varying conditions are expected to help in preventing fires that start themselves. At present, the Department of Agriculture reports, one out of every ten tons of hay cut in the United States is destroyed by spontaneous combustion due to storage under unscientific conditions.

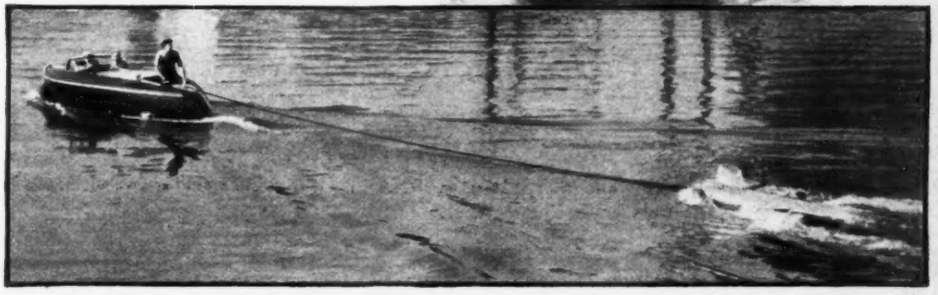
Inventor Gets Thrill in Homemade Submarine



Cutaway drawing of one-man submarine showing how the occupant lies flat with his head in the conning tower while the submerged craft is being towed slowly by a motorboat



Below, the inventor of the new sub peering from the conning tower, the top of which is raised. At bottom, a motorboat with the sub in tow. It can be dragged at thirty miles an hour on surface and at half that speed when it is totally submerged



HIS own invention, a one-man submarine, provides thrills for twenty-four-year-old James Bolar, Jr., of Oakland, Calif. He built the ten-foot craft in the basement of his home at a total cost of fifteen dollars for materials, and demonstrated it recently to astonished spectators in San Francisco Bay. Bolar enters a hinged conning tower, which is then sealed watertight by a rubber flap, and lies flat on the floor. A speedboat takes him in tow. When he wishes to submerge, hand levers tilt a pair of diving fins that work independently, one on each side. Through a heavy plate glass window he can see twenty feet ahead while being towed at slow speed. Perforations in the false bottom of the streamlined shell admit water to a ballast tank, reducing buoyancy. Bolar has submerged to depths of thirty feet, and has remained below the surface for half an hour without discomfort. He suggests possible uses for his craft, aside from sport, in hunting for sunken vessels and surveying harbor bottoms, or studying lake beds.

POISON GAS FOR LOCUSTS

FIGHTING plagues of locusts with poison gas, sprayed from airplanes, is proposed by British scientists. Four crates were recently shipped from Kenya, Africa, by air to London, England, where they are being carefully reared in breeding cages. They will be subjected to poison fumes to learn which vapors are most effective.

Live locusts, shipped by air from Kenya, Africa, are being carefully inspected before they are put in the electrically heated breeding cages, right, for further growth

PICTURES ILLUSTRATE NEW BOOK FOR BLIND

ILLUSTRATIONS with raised dots appear in the first practical picture book for blind children, recently issued. By running a fingertip over the outline of the picture, which resembles the dotted texture of Braille writing, it is possible to comprehend the form. The pictures, one is seen above, are colored.

Camera Catches Uncle Sam Making Billions of Dollars

PRINTING $2,000,000,000 worth of paper money gave the 5,000 employees of the U. S. Bureau of Printing and Engraving, at Washington, D. C., a rush job a few weeks ago—but the presence there of photographers was an even more extraordinary event. Special permission was granted by the U. S. Secret Service for them to take pictures of the making of bills, and two of the unusual views are reproduced here.

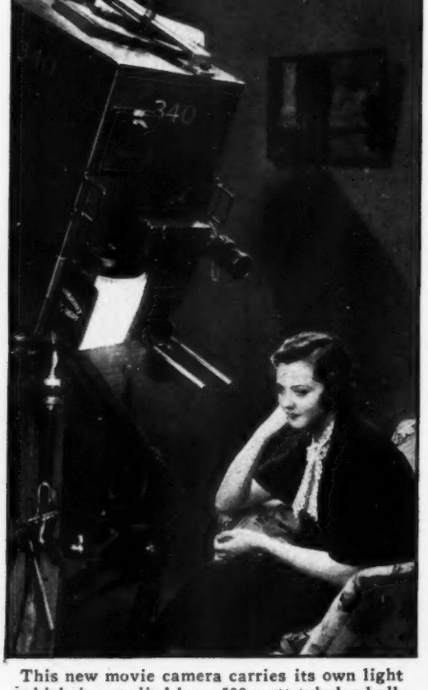
Even in a normal year, Uncle Sam's money factory turns out enough paper currency to encircle the earth four times. Every sheet of the special paper used must be accounted for. When not in use, the dies used in printing the bills are stored in a vault studded with mirrors so a guard can inspect the whole chamber at a glance. Electric alarms connect the vault with police headquarters and Army posts.

Printed in sheets of twelve, U. S. banknotes come to this trimming machine. There pneumatic fingers seize the sheets and knives trim the edges. Then bills are cut apart

At left are a few of the 240 presses that print paper money for Uncle Sam. Each one delivers a sheet of twelve notes, which are ready to go to the trimmer, every five seconds

SELF-LIGHTING CAMERA NOW USED IN MOVIES

A MOVIE camera that produces its own light is a recent innovation in a Hollywood, Calif., studio. It carries a detachable lamp with a 500-watt tubular frosted bulb upon a bracket at the front. In this way a continuous light is thrown on the face of an actress while the camera is moved around her for a close-up.



This new movie camera carries its own light which is supplied by a 500-watt tubular bulb

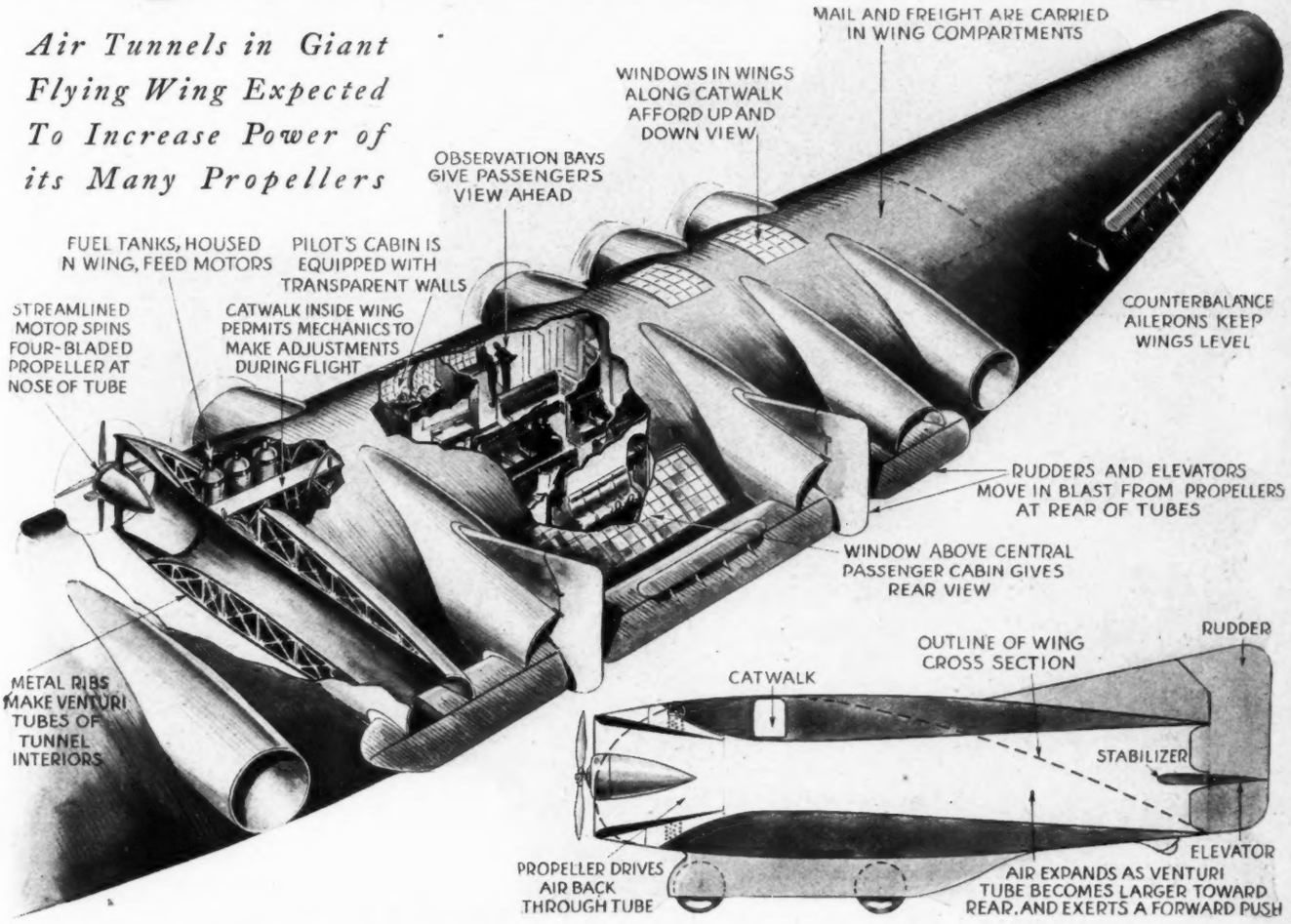
ONE MAN RUNS NEW TRENCH DIGGER

BY ADDING an endless conveyor to a gasoline driven cultivator of standard design, a Long Island City, N. Y., inventor has devised a one-man trench digger for military use. Soldiers equipped with these machines, he says, could dig themselves into an advanced position while under withering fire from the enemy lines. The space between opposing armies would speedily be transformed from an impassable No Man's Land to a labyrinth of ditches. For the digging unit, the inventor employs a type of revolving cultivator widely used for tilling farm soil. Motor-driven tines kick up the earth, depositing it on the conveyor to be dumped at one side. The trench digger can be operated by one man.

One-man trench digger as it would appear in action

Huge Barrel Plane for Ocean Flights

Air Tunnels in Giant Flying Wing Expected To Increase Power of its Many Propellers

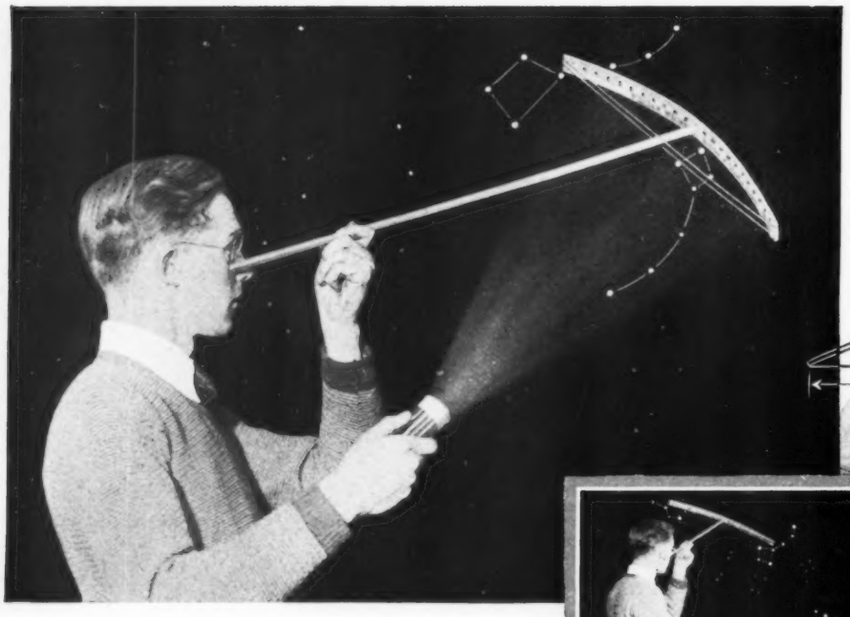

MAIL AND FREIGHT ARE CARRIED IN WING COMPARTMENTS
WINDOWS IN WINGS ALONG CATWALK AFFORD UP AND DOWN VIEW
OBSERVATION BAYS GIVE PASSENGERS VIEW AHEAD
FUEL TANKS, HOUSED N WING, FEED MOTORS
PILOT'S CABIN IS EQUIPPED WITH TRANSPARENT WALLS
STREAMLINED MOTOR SPINS FOUR-BLADED PROPELLER AT NOSE OF TUBE
CATWALK INSIDE WING PERMITS MECHANICS TO MAKE ADJUSTMENTS DURING FLIGHT
COUNTERBALANCE AILERONS KEEP WINGS LEVEL
RUDDERS AND ELEVATORS MOVE IN BLAST FROM PROPELLERS AT REAR OF TUBES
WINDOW ABOVE CENTRAL PASSENGER CABIN GIVES REAR VIEW
METAL RIBS MAKE VENTURI TUBES OF TUNNEL INTERIORS
OUTLINE OF WING CROSS SECTION
RUDDER
CATWALK
STABILIZER
ELEVATOR
PROPELLER DRIVES AIR BACK THROUGH TUBE
AIR EXPANDS AS VENTURI TUBE BECOMES LARGER TOWARD REAR, AND EXERTS A FORWARD PUSH

PIERCED by a battery of tunnels a flying wing airplane is proposed by an engineer at the famous Caproni airplane works in Italy. Streamlined motors and four-bladed propellers will drive air blasts through the tunnels, each of which forms a Venturi tube, expanding toward the rear. Thus, according to the inventor, the air will give a forward push something in the manner of rocket propulsion. Aided by the Italian government, the designer recently completed a single-engined experimental craft incorporating his ideas. This odd flying barrel was put through successful tests near Rome. (P.S.M., Jan. '33, p. 18.) Details of the huge machine he proposes to build for transatlantic travel are shown in the pictures above. A half-dozen tunnels or more will run through the immense flying wing. Rudders and elevators will be mounted so they will move in the blasts issuing from the tubes. The craft will be piloted from a cabin with transparent walls at the center of the leading edge of the wing. On either side will be observation bays from which passengers can look ahead. Other windows will afford a rear view from the central passenger's cabin. Another feature of the machine will be a catwalk running lengthwise through the wing. It will enable mechanics to make adjustments while the plane is in flight.

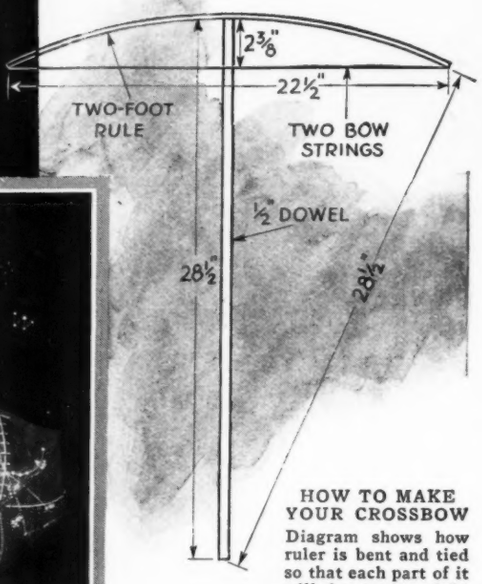
MODEL OF ROME IN 100 PARTS

LIKE fitting together a monster jigsaw puzzle is the task of assembling the sections of an immense model of ancient Rome, which has just been presented to the Pennsylvania Museum of Art at Philadelphia. It is composed of about 100 sections, and covers an area thirty-feet long and twenty-one feet wide. It was executed by Paul Bigot, noted architect and archaeologist. The illustration at right shows the model taking shape in the museum where it will illustrate the architecture of the old city.

How *to* *with a*

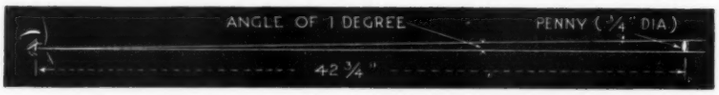


In using the crossbow, rest the bottom end of the stick on the cheek bone, place one end of the bow ruler on one of the stars and read off the point where the other star touches the ruler. Above, measuring the number of degrees between the bowl of the dipper and the Guards. Right, consulting umbrella map while sighting stars



HOW TO MAKE YOUR CROSSBOW

Diagram shows how ruler is bent and tied so that each part of it will be twenty-eight and a half inches from your eye when you use it



Any round object, like the penny above, held at fifty-seven times its diameter from the eye will occupy an angle of just exactly one degree

• Manner of Making a Simple Astronomical Instrument and a Perpetual Map of the Sky Is Explained in Detail in This Article for Amateurs

By GAYLORD JOHNSON

KNOWLEDGE of the principal star groups precedes any real pleasure in stargazing.

When you can recognize at a glance about two dozen groupings that contain important stars, you have learned the geography of the sky. You can then wander in skyland at will, and explain its points of interest to others. You can indicate the brightest of the sparkling suns and say, "There is Arcturus. There is Vega, and there are the Guards, the two stars that Columbus sailed by when he discovered the New World."

Knowing the stars by name, you will welcome the reappearance of characteristic spring star groups as heartily as you welcome budding trees and milder days. You will soon look upon these strangely imagined star animals and people as old familiar friends, that can always be found in their expected places.

Nearly every one has at least two friends among the stars—the "big dipper" and the "polestar." In the last article I told how to tell time by following the twenty-four-hour rotation of the dipper around the pole. Now we shall start with the umbrella, on which you have chalked a few stars, and show the principal star groups that are visible at the different seasons. Then we shall invent a simple device that will enable us to find these stars at any time of the year.

A glance at the two pictures of the umbrella shown makes it plain that the nine o'clock appearance of the northern sky changes from season to season.

Look closer and you will see that the big dipper rotates through a quarter turn around the polestar in three months. Also you will see that the four main groups around the polestar can be joined by two lines crossing at right angles.

A line from the dipper crosses the pole and meets a sprawling "W" or "M" about the same distance on the other side. This "W" group is Cassiopeia.

The other line, crossing the first at right angles, runs from a small group at the east of the pole, containing the single bright star, Vega, to a group of five west of the pole. The five form the constellation Auriga. The brightest of them is a brilliant yellow-white sun named Capella.

These four, one for each season, constitute our key groups. Using them as landmarks, we can find all the star groups at any time of the year, for some one of them is always in a good position from which to run lines that will help us find the other constellations of the season.

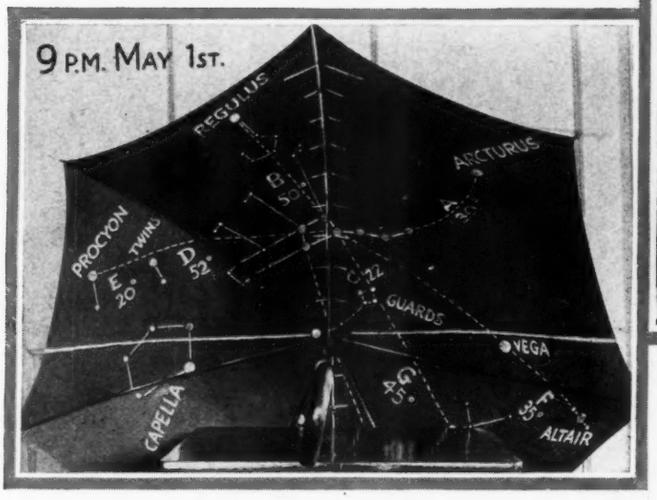
Notice in the illustrations that both the dipper and the W are cut by the third short white parallel line, counting from the pole. Each of the spaces between these short lines, extending along our umbrella's ribs from side to side, represents ten degrees. The dipper and the W are each therefore about thirty degrees from the pole. It takes six more divisions to reach the edge of the umbrella—ninety degrees in all from the pole of our miniature sky to its equator.

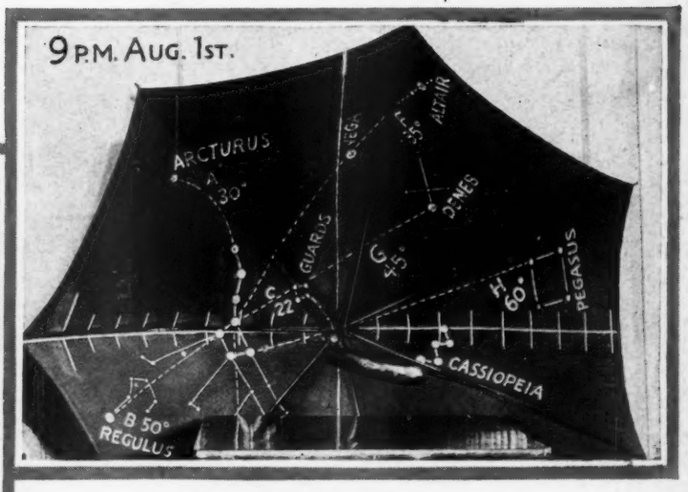
At this point you may ask, why can't we make a measuring rule, marked off in degrees, hold it up toward the real sky, and thus find all the other principal stars by their distance in degrees from the pole and from each other? We can. That is just what we are going to do, but first we must know the length of a degree.

Here is a simple rule that tells us exactly what we want to know: Any round

Find the STARS

Crossbow





How You Can Find the Important Spring and Summer Star Groups in Northern Hemisphere

A To find Arcturus, imagine the curving handle of the dipper to be made much longer. Place the end of the bow ruler on the last star in the handle, with the rule extended along the handle. At thirty degrees along the rule you will find Arcturus

B To find Regulus, in the Lion, hold the bow along a line joining the two stars on the side of the dipper next the handle. Place the end of the rule at the star where handle joins bowl. The ruler will point out a bright star fifty degrees from the dipper. This is Regulus

C To find the Guards, extend the line above the bowl of the dipper. Place the ruler along this line with end at star where handle joins bowl. Twenty-two degrees above the dipper are the sought-for Guards

D To find Castor and Pollux, extend the line of the dipper's handle through the star diagonally across the bowl. Hold end of ruler on this star and continue line fifty-two degrees at which point are twins

E To find Procyon, extend the line used to find Castor and Pollux twenty degrees beyond them to two main stars. The brighter is Procyon

F To find Altair, hold the ruler along a line from the star where the dipper's handle joins the bowl. At thirty-five degrees along this line beyond Vega you will find Altair

G To find Deneb, extend the line used in finding the Guards on beyond those stars. At forty-five degrees farther along you find Deneb

H To find Square of Pegasus, extend line from dipper's pointers to the polestar. At sixty degrees beyond the pole you find four bright stars and at their side is the Square

object held at fifty-seven times its own diameter from the eye, occupies an angle of one degree. You can use a button, a coin, or a dinner plate.

Take a copper cent and measure its diameter. It is exactly three-fourths of an inch. How far must it be held from the eye to occupy an angle of one degree? Obviously, fifty-seven times three-fourths or forty-two and three-fourths inches.

To get a satisfactory measuring rod, hold a two-foot ruler at such a distance from the eye that each one-half inch division will occupy the angle of one degree. To do this the ruler must be held fifty-seven times one-half inch, or twenty-eight and one-half inches, from the eye.

If we do this with a *straight* ruler, however, it is obvious that the divisions at the ruler's ends will be more than twenty-eight and one-half inches from the eye. To correct this error we must bend the two-foot rule into a bow and fasten it by its center to a stick that is twenty-eight and one-half inches long. Then we shall be able to measure forty-eight one-half inch degrees in any direction on the curving bowl of the sky. With it, you can find the angular distance between any two stars, just as a ship captain does with his sextant.

To use your instrument, rest the bottom end of the stick upon the cheek bone below your eye, place one end of the bow ruler on one of the stars, and read off the point where the other star touches the ruler. The observer in the illustration is using his crossbow to measure the number of degrees between the star where the dipper's handle joins the bowl and the pair of stars called the Guards. With the end of the bow ruler at the star in the dipper, the Guards fall at a point about twenty-two degrees along the edge of the ruler. This corresponds to twenty-two half-inches or eleven inches on the curved bow ruler.

In making my instrument, I used an ordinary hardware store yardstick and a half-inch dowel rod. In order to see the divisions, when the bow ruler is held up against the sky, I notched its edge at two and one-half inch intervals. If I want a more precise measurement, I turn on a flashlight and note the exact half-inch division where the star touches the edge.

At nine p. m., about the first of May, the dipper is above the pole with Vega almost straight east of it. About the first of August, at the same hour, the dipper hangs down at the left of the pole, with Vega high above it.

During May, June, and July, Vega and the dipper are excellent finger posts for finding all the other principal stars of the early summer sky. Now with the aid of your crossbow you are ready to go out and find a few stars.

If you read over the series of six paragraphs, lettered A, B, C, etc., and look at the dotted lines lettered to correspond in the other illustrations, you will know exactly how to use your bow ruler in finding each star. Then, if you have chalked upon your umbrella the necessary lettered and numbered lines, you can take it out and use it as a memorandum of directions and distances, to be consulted with the aid of your flashlight.

It is easy to make a two-faced star chart that will show on one side the constellations in view in the Northern Hemisphere of the sky at a certain hour in the evening, and on the other side the groups to be seen at the same time south of the sky's equator.

To do this, take a piece of heavy cardboard thirteen inches square. Cut from its center a perfectly circular piece ten inches in diameter.

Then, using a compass and straightedge, enlarge the circular plans shown on page 44 to nine and one-fourth inches in diameter, exclusive of lettering around edge. The radial lines are sixty degrees apart. Divide the radius into nine equal parts and describe concentric circles. It is then

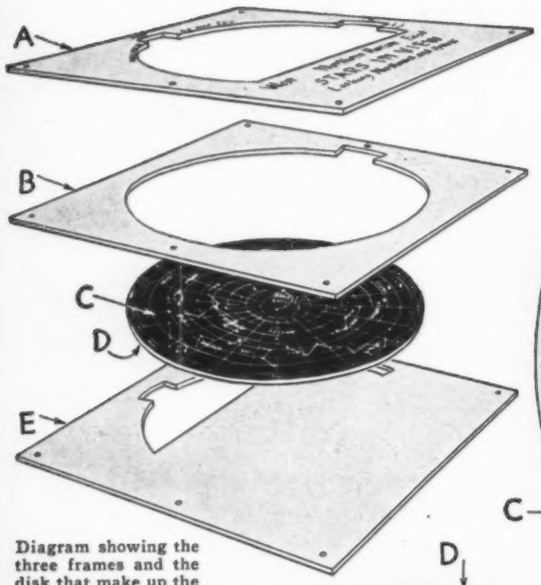
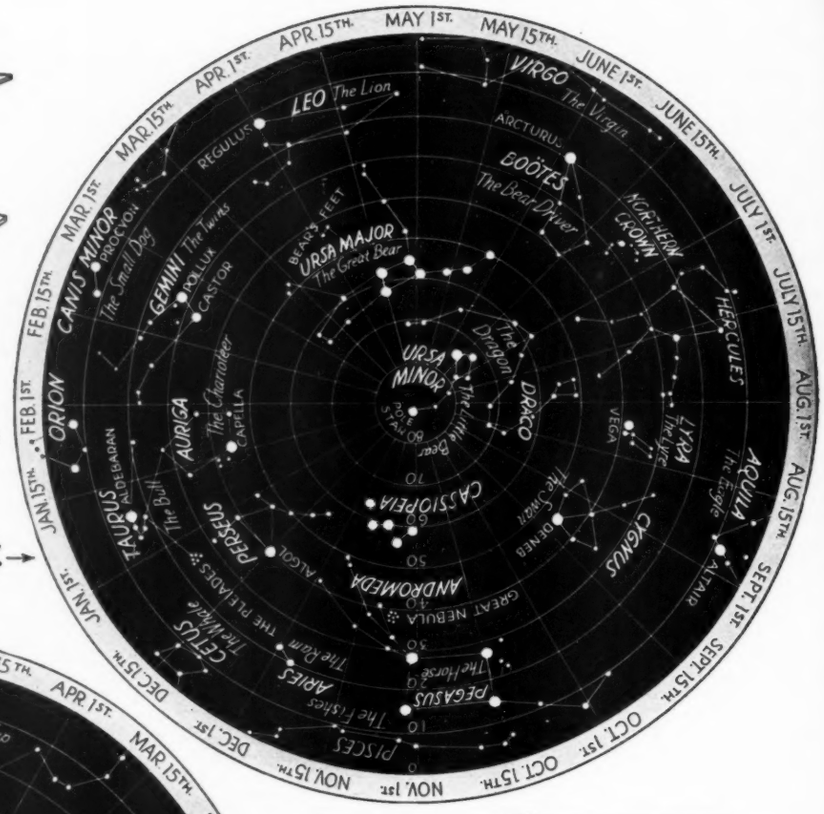
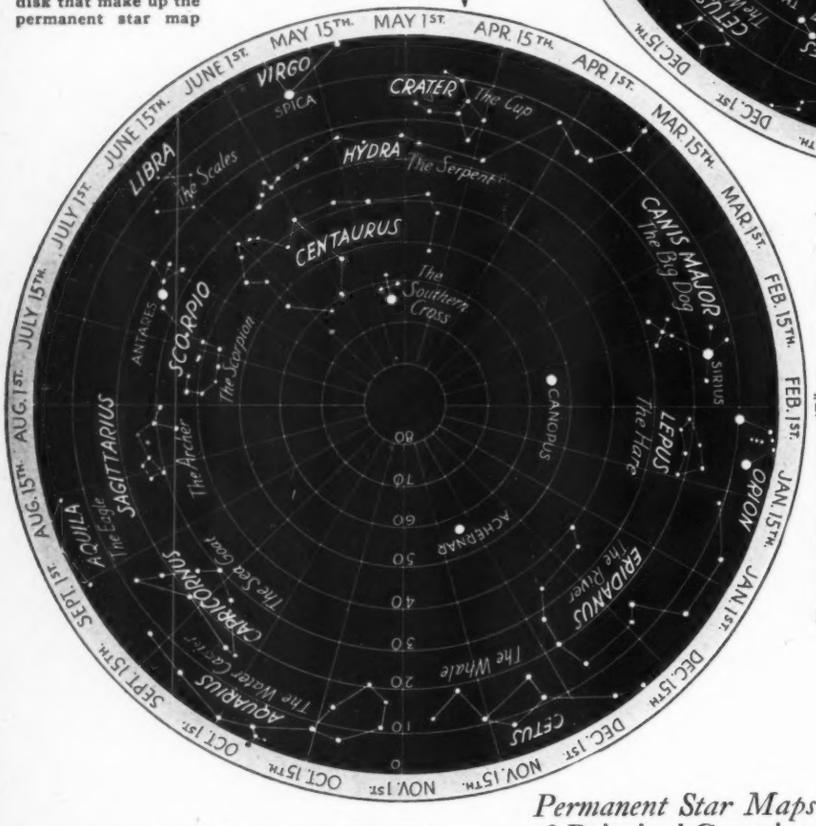
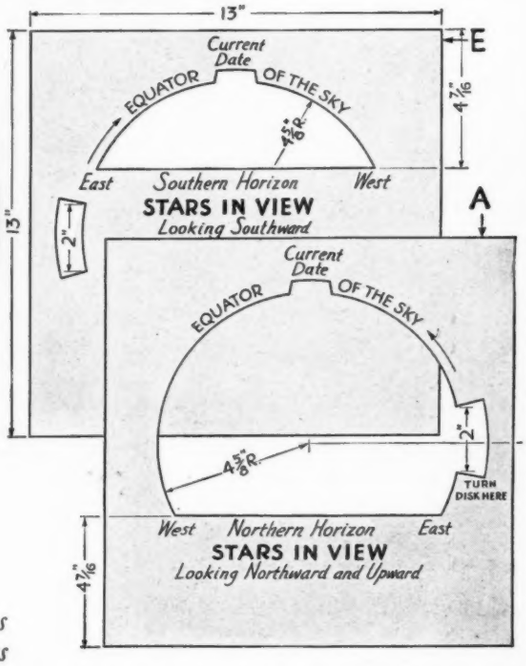


Diagram showing the three frames and the disk that make up the permanent star map







Permanent Star Maps of Principal Groupings

The diagrams above and at right show how to make a two-faced star chart containing on one side the stars of the Northern Hemisphere and on the other the stars south of the sky's equator. Complete directions for cutting the dial disk and frames and for accurately locating the stars on the charts are given on this page. Frames and disk can be cut from cardboard in the dimensions indicated, although a more durable map, of course, can be constructed of plywood, thick celluloid, or other like material

an easy matter to locate the stars and constellations on your charts by reference to the diagrams. The charts shown here were made on black paper with white ink, but black lettering on white paper is equally effective. If you live in a city and do not wish to go to the trouble of enlarging the charts, you can take the page from this magazine to an office that makes photostat prints and have both plans enlarged to ten-inch circles for about a dollar. (See note on opposite page.)

When your two circular plans are enlarged glue them firmly to the two sides of the ten-inch disk. Make sure that the month names and their corresponding lines are exactly opposite. When the disk is complete, replace it in the hole from which it was cut. Sandpaper the edges.

From strong cardboard make the two square masks shown in the small drawings and glue them to the square frame of cardboard from which you cut the disk, with the curved sides of the mask openings toward the top. Glue the mask which has the larger opening over the face of the disk on which the big dipper and northern polar stars appear. The parts may also be fastened together with clips or rivets or by binding their edges with adhesive tape. Cut recesses at the top of the masks, as shown in the small drawings, so that the time of month will be visible on the disk containing the star charts; also cut openings at the sides of the masks and in center frame so you can turn the dial.

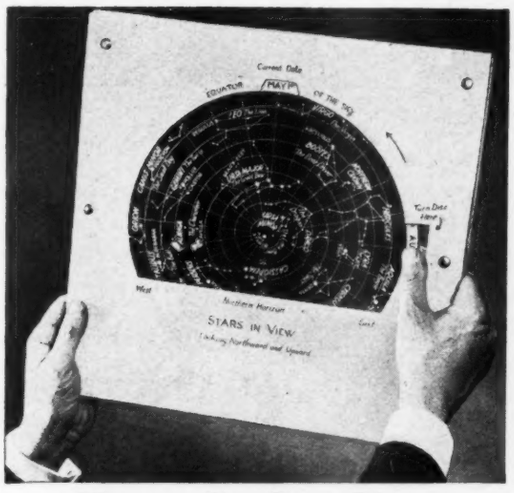
The two masks now hold the disk in place, yet allow it to revolve freely. As it turns, the fourth circles from the north and south poles should just touch the horizon lines. This applies to all places near the latitude of New York City, that is, forty degrees, north. In making the

star map for a place ten degrees north of this, the mask opening having the northern horizon line must be extended downward until the horizon line touches the fifth circle below the north pole, but the bottom edge of the mask-opening having the southern horizon must be cut higher. It should just touch the fifth circle above the south pole of the sky. *Opposite* changes must be made for a place ten degrees south of the latitude of New York City.

When your star chart is finished, turn the disk slowly with thumb and finger, and you will see the stars in view at nine o'clock at intervals of two weeks throughout the year. Note that we see more of the northern half of the sky than we do the southern. At the north pole we should see only the Northern Hemisphere, with the polestar straight overhead. At the equator we should see northern and southern halves of the sky equally, with the north polestar on the northern horizon, and the faint south polestar, Sigma Octantis, on the southern horizon. The belt of Orion, which is almost exactly on the equator of the sky, would then pass over our heads during winter nights.

Now that you have learned to know some of the sky countries by sight, you are ready to get your first thrills from seeing through a magnifying glass of moderate power some of their principal points of interest. The next article will give you the high spots of Opera Glass Astronomy. You will be surprised at how much you can see through a binocular magnifying ten times, or even through an opera glass magnifying three or four times.

The great Galileo proved his theories and revolutionized the accepted ideas of the universe with the aid of a rude telescope that was no more powerful than is one tube of a modern opera glass. As I have said in earlier articles, elaborate equipment is by no means essential to understanding and enjoying the grandeur of the heavens, nature's greatest show. Indeed, important discoveries in astronomy have been made with just the kind of simple equipment I have described.



How to Get Star Charts

HERE is the way your perpetual star chart will look when completed. For the readers who may not wish to go to the trouble of enlarging the charts from the illustrations on the opposite page, POPULAR SCIENCE MONTHLY *has prepared full-sized reproductions of them. These, with directions for preparing the frames, will be sent to any address on receipt of 25 cents. Print name and address and send your order to Blueprint Department,* POPULAR SCIENCE MONTHLY, *381 Fourth Avenue, New York City.*

Airplane Camera, on Ground, Takes Pictures of Invisible Things

OBJECTS so far away they can not be seen are revealed by the latest aid to news photographers—a camera that cuts through haze with special filters and plates sensitized to infra-red rays. Originally developed for long-range aerial photography, the equipment is now being used effectively on the ground. The striking example above shows New York City's skyline viewed across five miles of water. The Empire State Building, at left, is nearly nine miles away.

Great Men of Korea Ride Safely on One Wheel

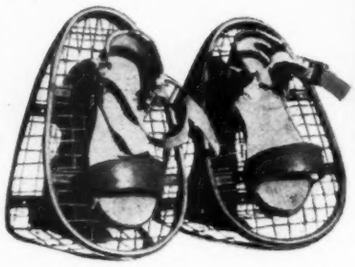
General of Korea, attired in full dress for formal visit, goes forth riding on a one-wheeled carriage that is propelled by his servants

RIDING on one wheel may convey an impression of reckless driving, but it is a slow and stately form of locomotion in the Asiatic land of Chosen (Korea). When a dignitary prepares for a trip, he dons a costume that properly reflects his power and prestige, and mounts a vehicle like the curious single-wheeled carriage pictured here. Four strong coolies seize the guiding bars and trundle him toward his destination. Judging from appearances the passenger must necessarily be resigned to a certain amount of rather rough joggling.

Wire shoes are worn by oystermen to keep them from sinking in silt. Left, view of latticework construction

WIRE SHOES FOR OYSTERMEN

RESEMBLING snowshoes in an abbreviated form, shoes of wire latticework have been invented by J. J. Brenner, of Olympia, Wash., for use by oystermen. Ordinarily the soft bottom of the oyster grounds does not readily support a man's weight, and he is likely to sink in at each step. This not only makes walking difficult, but also forces small oysters into the bottom where they become covered with silt and die. Use of the new footgear is expected to end the loss of oysters from this cause.

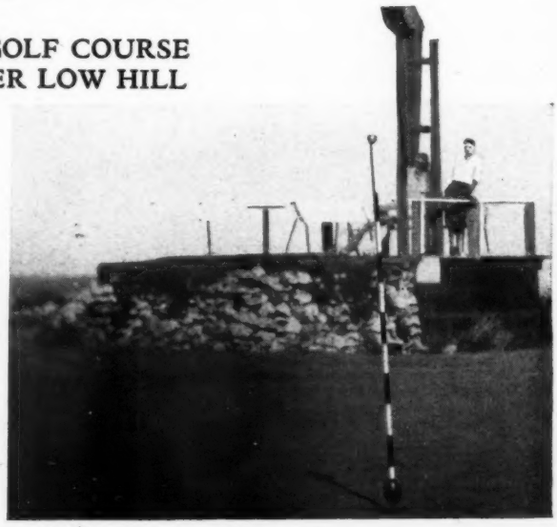


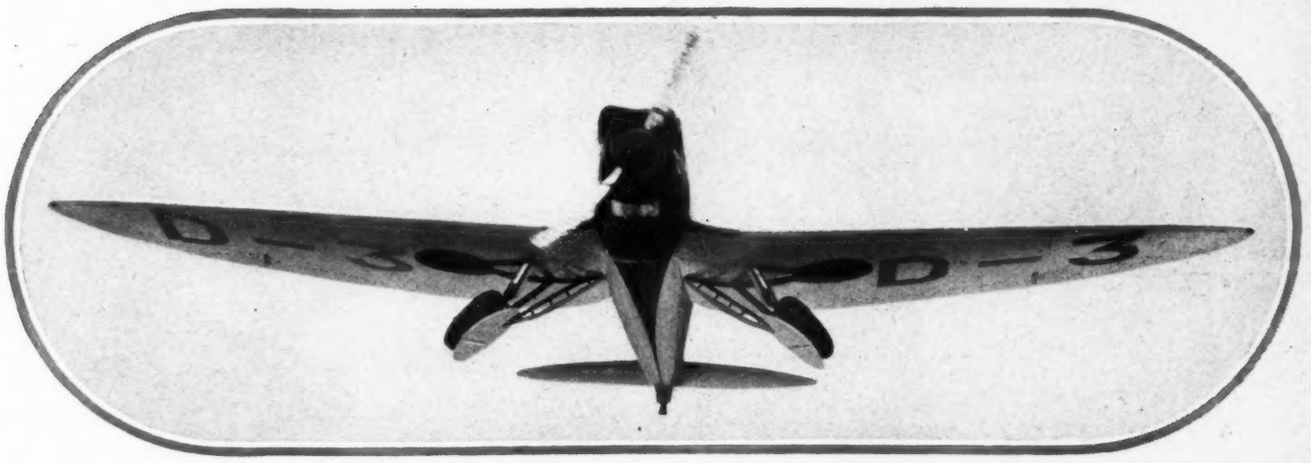
DIAL CHECKS UP IGNITION

WHETHER your car's ignition is working properly is revealed at a glance by a new indicator dial for the steering post, shown above. When each spark plug fires, a blue spark is seen in a numbered window of the fireproof dial. A dark window shows that a cylinder is missing fire and the number indicates which one, permitting quick repair and preventing overheating and fuel waste. Special spark plugs, upper right, have terminals for wires leading to dial.

PERISCOPE ON GOLF COURSE GIVES VIEW OVER LOW HILL

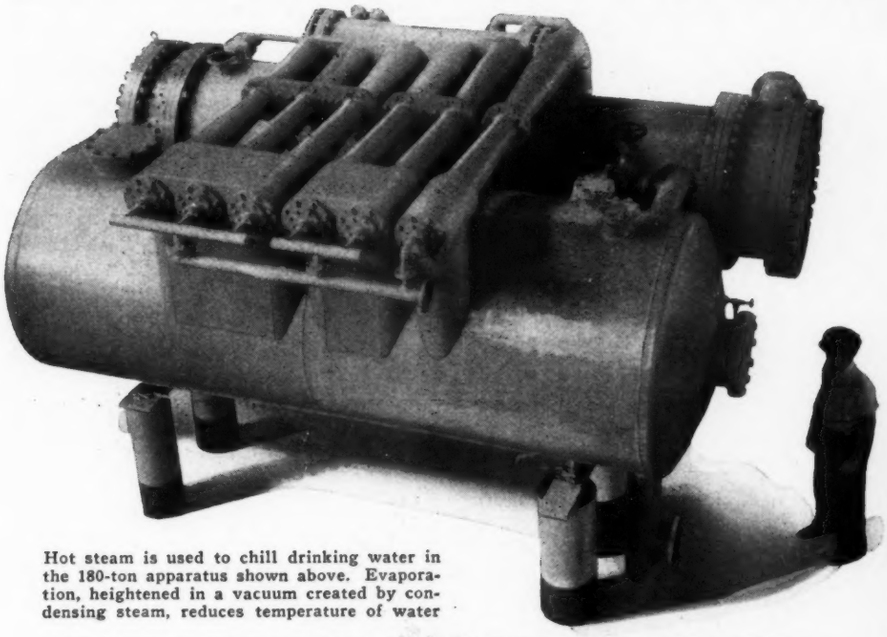
PROBABLY one of the most unusual golf devices in the world is on a Canadian course at Victoria, B. C. A small hill rises between the ninth and tenth holes, making it impossible for a golfer to see where to aim his ball. To remedy this difficulty, a periscope approximately twelve feet in height has been erected at the ninth hole, as illustrated at right. Before driving toward the hidden hole, a player gets his bearings by looking over the hill through the periscope.





Landing Wheels Vanish into Plane's Wings During Flight

How modern planes increase their speed by withdrawing wheels into wings, after the take-off, is strikingly illustrated above. The photographer snapped a new German craft soaring overhead at the moment the pilot was operating the retractible gear of the latest type. The wheels are seen about to disappear into holes in the wings, which are then closed by plates. When the wheels are let down for a landing, the hinged cover plate swings sideways to clear the ground.



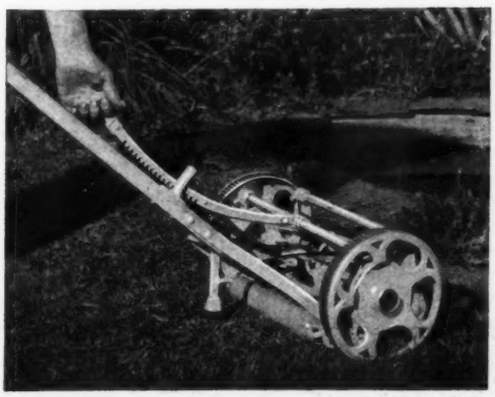
Hot steam is used to chill drinking water in the 180-ton apparatus shown above. Evaporation, heightened in a vacuum created by condensing steam, reduces temperature of water

HOT STEAM COOLS DRINKING WATER

USING hot steam to chill drinking water is the feat that will be performed in a New York bank building by the 180-ton outfit illustrated above. Water sprayed into the front tank cools itself by its own evaporation, which is greatly accelerated by a high vacuum maintained throughout the apparatus. This vacuum is produced by allowing steam to condense in the rear tank. Part of the chilled water is drawn off for drinking, while the rest is run through pipes to cool the building.

NEW ELECTRIC FAN HAS RIBBONS FOR BLADES

WHIRLING loops of ribbon replace metal blades in an accident-proof electric fan recently exhibited by a German inventor and illustrated below. Since there is no danger that the user may suffer a cut hand by reaching toward it in the dark, the fan is especially recommended for bedside use. Revolving on a shell around the tiny motor, the three tabs of ribbon provide a gentle circulation of air.



LAWNMOWER CUTS UPSIDE DOWN

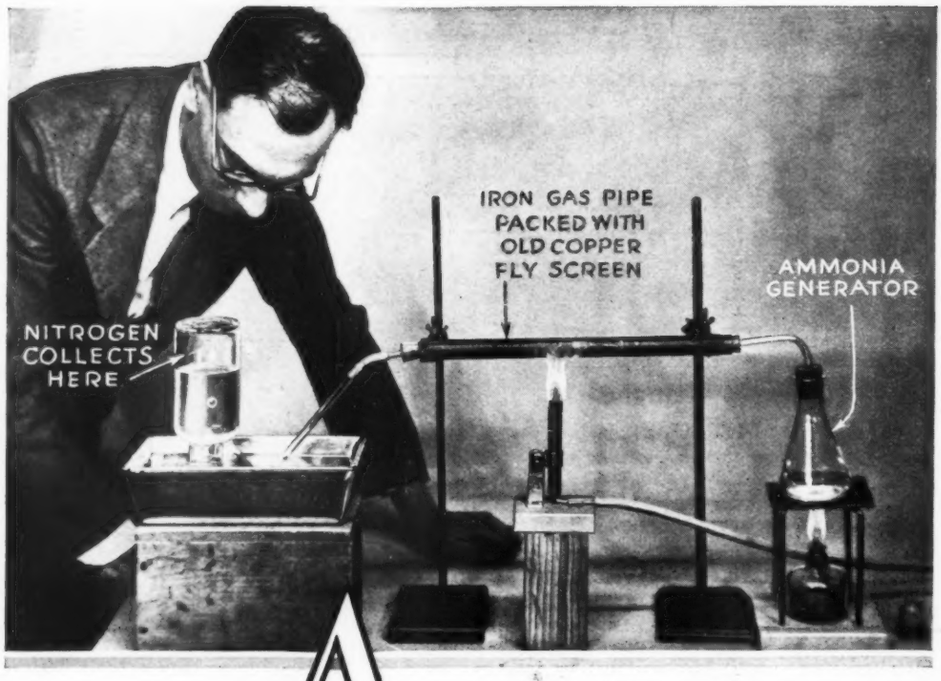
A LAWNMOWER that runs in reverse has recently been placed on the market. Normally it is pushed but a special frame permits it to be used upside down for trimming under shrubbery. The cutters will then revolve only when the mower is drawn toward the operator. Terraces may be trimmed from below in the same way. The height of cutting is adjustable from one-half to three inches, to suit the condition of the lawn, by a ratchet lever on the handle, as shown at left.

PLUG CLEANS OIL IN CRANKCASE

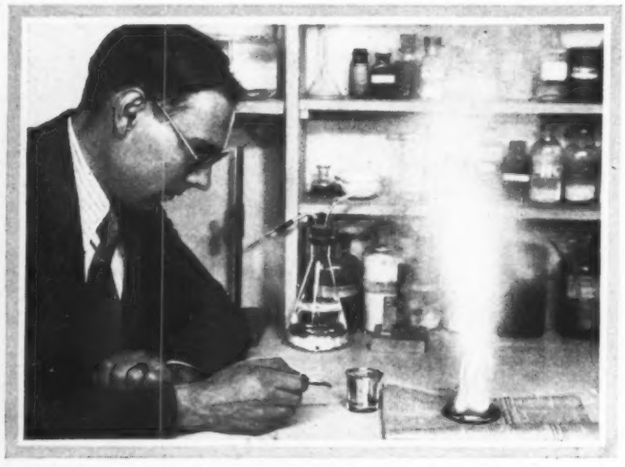
MOTORISTS are now offered a magnetic drain plug that abstracts foreign particles of metal from oil circulating in the crankcase, reducing wear on a car's motor. When oil is drained, the metal may be brushed off the plug. It is shown, left, before installation, and, above, after several hundred miles' driving. The pole pieces are permanently magnetized.

COLLECTING NITROGEN

The apparatus shown here is used to get nitrogen from ammonia. Copper fly screening, rolled up, is placed inside the short iron pipe. A tube from the ammonia generator leads into this pipe, and an outlet tube leads from the other end to a tin filled with water in which a bottle of water is inverted. Heating pipe and then flask removes hydrogen in pipe while nitrogen enters the bottle



Surprising Tests WITH Household AMMONIA



By carefully adding water to a mixture of ammonium nitrate and zinc dust, you can produce a spontaneous flame. As the water is added, as shown, the mixture bubbles, smokes and burns

IT IS surprising what the amateur chemist can do with a fifteen-cent bottle of ordinary household ammonia.

Being a mixture of ammonia dissolved in water, this pungent-smelling liquid offers an ever-ready supply of ammonia gas for the home laboratory. Even at room temperature, the gas is released from the liquid. By heating it, the experimenter can obtain the gas in larger quantities.

Strictly speaking, household ammonia is not ammonia at all, but ammonia water or ammonium hydroxide. Although ammonia can be liquefied, it is a colorless gas at normal temperatures. The fact that it dissolves readily in water makes the manufacture of ammonia water possible.

You hardly would suppose that the fumes rising from an open bottle of household ammonia are inflammable. Yet, ammonia gas can be burned. To demonstrate this, place an ounce or two of household ammonia in a small flask. Fit the mouth of the flask with a cork containing a metal or glass outlet tube and heat it. Ammonia gas will flow from the outlet tube and a match held close to the tip will cause the gas to burn as long as the match flame is present. If the outlet tube is placed in an atmosphere of oxygen, the ammonia gas will not only flame but will burn steadily.

Like hydrogen, ammonia gas is lighter than air. For this reason it can be collected by holding an inverted bottle over the mouth of the generator flask. When the bottle has filled, it can be tipped upright by closing its mouth with a flat card or square of glass.

Collect a bottle of the gas and seal it with a card in this manner. If the bottle is then righted, the card removed, and a burning match dropped in, the gas will flame and glow slightly as it burns.

Household ammonia often contains impurities such as soap and oleic acid that make it unfit for use in experiments requiring pure ammonium hydroxide. The amateur chemist can prepare pure ammonium hydroxide, however, by heating some household ammonia and allowing the gas evolved to bubble through water. Make some, place it in a rubber-stoppered bottle, and label it "ammonium hydroxide." You'll find that it will be a useful addition to your stock of chemicals.

It has been found that as many as 700 volumes of ammonia gas can be dissolved in a single volume of water. This particular property forms the basis of an interesting fountain experiment similar to the one described some months ago in connection with sulphur compounds (P.S.M., Sept. '32, p. 50).

First, select a large-mouthed bottle and fit it with a cork having a hole through its center. Push the glass portion of a straight medicine dropper through this hole so that the tip of the dropper is inside the bottle, and connect a short length of rubber tubing to its outer end. Fill the tube and dropper with water and snap a pinch clamp over the middle of the tube.

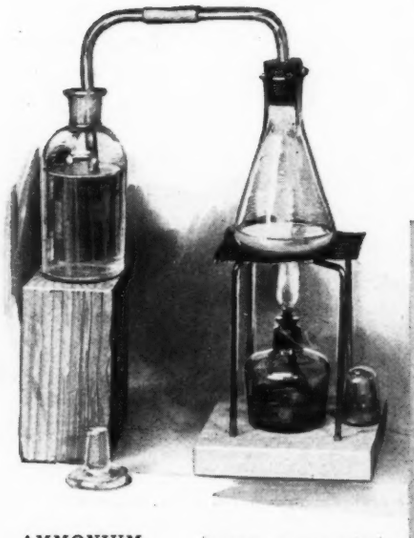
FILL the bottle with ammonia gas by inverting it over a heated flask containing household ammonia and quickly insert the cork containing the dropper. By squeezing the rubber tube above the clamp you can cause some of the water in the tube to flow into the bottle and dissolve some of the gas. This will form a partial vacuum inside the bottle.

Holding the bottle inverted, immerse the lower end of the rubber tube in a beaker or glass of water and remove the pinch clamp. The vacuum in the bottle will suck the water up through the tube and dropper and create a miniature fountain.

You can make the effect more mystifying by placing several drops of phenolphthalein solution in the water before you open the pinch clamp. The water will remain colorless until it enters the bottle.

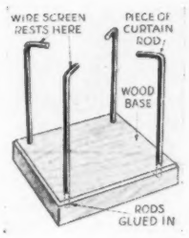
Simple Experiments and Home-made Apparatus Extend Your Knowledge and Speed the Work You Can Accomplish in Your Own Laboratory

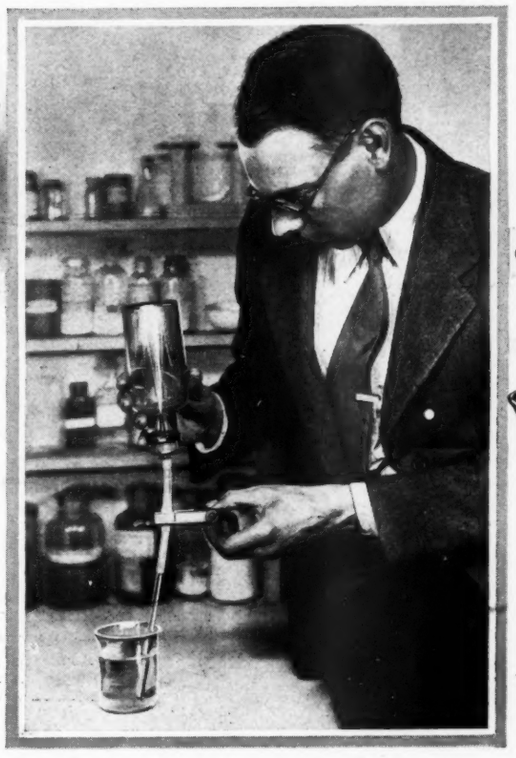
By RAYMOND B. WAILES



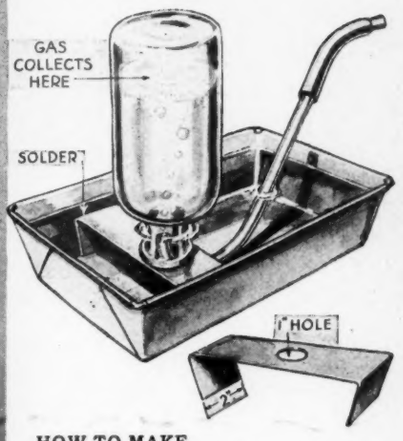
AMMONIUM HYDROXIDE

With the apparatus seen above, ammonia gas is evolved by heat and passes into the bottle of water at left where it dissolves to form ammonium hydroxide. At right, how the stand for flask is easily made





Having filled a bottle with ammonia gas by inverting it over a heated flask containing household ammonia, insert a cork containing hose and dropper which are full of water. Squeeze the tube to force water into the bottle. Then holding the bottle inverted, release the clamp. Water will be drawn through the tube and spout as a small fountain in the bottle. Drawing below shows the construction of the little pinch clamp



HOW TO MAKE PNEUMATIC TROUGH

Drawing shows how trough, used in collecting nitrogen, on page 48, is made

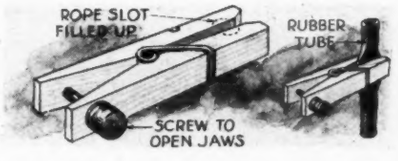
As it mixes with the gas, however, it will turn red because of the alkali effect of the ammonium hydroxide formed.

When heated with a caustic, such as lime water or lye water, all ammonium compounds decompose to form ammonia gas. For instance, if sal ammoniac is mixed with powdered lye and water, ammonia gas is evolved without the presence of heat. This, by the way, is a very simple and inexpensive way to prepare ammonia gas in the laboratory. Sal ammoniac can be purchased in any drug store and almost every home has a can of powdered lye on hand. The same type of reaction will take place if the sal ammoniac is mixed with lime water, excepting that in this case heat will be necessary to complete the process.

WITH certain types of ammonium salts and alkalies, you do not even have to add water to produce the ammonia gas. Sodium carbonate (soda ash) and ammonium chloride, both odorless substances, will react to form ammonia gas when they are rubbed in the palms of your hands.

Another simple way to make ammonia gas is to heat certain types of organic matter such as hair or pieces of animal horn. As a laboratory experiment, the amateur chemist can place some finger nail clippings in a test tube and heat them. A small piece of red litmus paper dampened and placed at the mouth of the tube will detect the alkaline trace of the ammonia gas evolved. This experiment can be made more effective by placing a small amount of dry lime or lye in the tube with the nail clippings. Incidentally, when handling lye it is best to use a glass or metal scoop.

Since ammonia and all its compounds contain nitrogen and hydrogen, the gas can be decomposed by the experimenter to obtain nitrogen. This is done by passing the gas over a hot metallic oxide. In the process, the hydrogen in the ammonia combines with the oxygen of the oxide, forming the metal and water, and the free nitrogen gas is released.



In the home laboratory the chemist can perform this experiment with a simple piece of apparatus assembled from various odds and ends.

SOME copper fly screening is first made into a small roll about eight inches long and placed in a short length of iron gas pipe. The outlet tube from an ammonia gas generator is led into one end of the pipe through a tight-fitting cork while a long outlet tube having a flexible rubber joint is fitted through a cork in the other end.

The entire apparatus should be arranged high enough to permit the iron pipe and the generator flask to be heated. The flask can be placed on an improvised stand made from short lengths of ten-cent curtain rods. The rods should be bent at the proper points and threaded or glued into holes in a small wooden base. A square of iron fly screening placed over the uprights will support the flask.

With the ammonia generator disconnected, heat the iron pipe with a gas burner. This will cause the copper screening to become oxidized, forming a coating of copper oxide. Then connect the generator, apply heat, and immerse the end of the outlet tube leading from the other end of the iron pipe in the water-filled collecting trough.

THE trough can be made from a ten-cent baking tin by soldering a bridge-like strip of tin across one end at such a height that it will be below the level of the water. Fill an empty bottle with water and carefully place it inverted on the bridge directly over an inch hole cut in the metal.

When the generator flask is heated, ammonia gas will be released and will flow over the heated copper oxide in the iron pipe. The hydrogen is removed from the ammonia by the hot oxide and the pure nitrogen gas bubbles from the outlet tube.

To collect the gas, place the outlet tube under the hole in the metal bridge supporting the bottle in the trough. The gas will bubble up int the bottle and displace the water. When the bottle is completely filled with the gas, carefully slip a piece of glass under the mouth and remove it from the trough.

By experi- *(Continued on page 94)*

• *Latest* INVENTIONS

SEATS, BED, AND DIVAN. Those who live in small apartments will be interested in the three-in-one couch seen below. It is a davenport, opens as a bed, and seats four for bridge

SOAP IN A DISHWASHER. A chamber in this dishwasher holds soap, so that dishes can be sprayed with soapy water. Then at a touch of a lever, they may be rinsed off with clean water. It is easily attached to a faucet

KILLS VIBRATIONS. The caster shown at left absorbs vibrations when placed beneath the leg of a bed or chair, thus adding greatly to comfort of an invalid

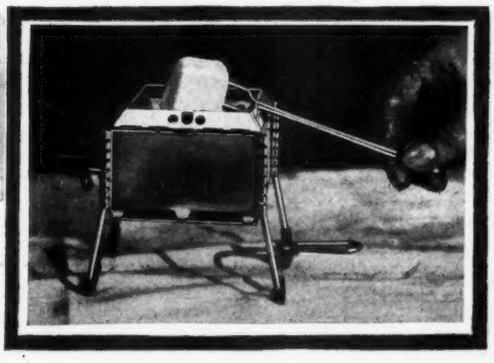
A MOISTURE GAGE. This sensitive meter instantly indicates any change in humidity and helps you avoid dryness

OPENER GUARDS DOOR. The bottle opener, right above, can also be used to stop a keyhole and prevent the use of skeleton key, as shown at left

SUN LAMP FOR THE HOME. Any ordinary bridge lamp is converted into a violet-ray sun lamp by merely connecting up the convenient adapter seen above. Installed without tools

NUT CHOPPER. When the full container is tilted and the handle turned, nuts or fruits are chopped

TOASTS YOUR MARSHMALLOWS. Heated by electricity, the toaster shown below quickly barbecues marshmallows. It is provided with three forks



Make Home Tasks Easy •

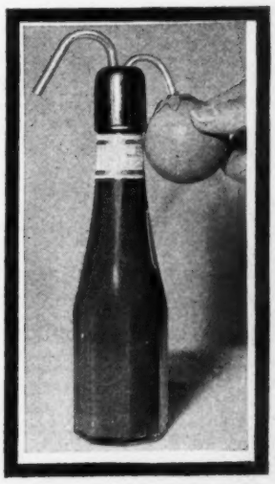
KEEPS OUT UNWELCOME VISITORS. With the radio device, pictured below and at left, you can talk to a caller at the front door, from any room and identify him by his voice without the necessity of opening the door. No earphones are used and the announcer is quickly turned on. Two-way conversation is possible

SPRINKLER FILLS ITSELF. Immersing this sprinkler in a bowl of water fills it. Made of aluminum, it is non-breakable and may be used to sprinkle water or moth killer

TWO LIGHTS IN ONE. Installed in the base of this bedside lamp, is a night light with a moveable shade and operated by a switch separate from main light which is turned on as desired

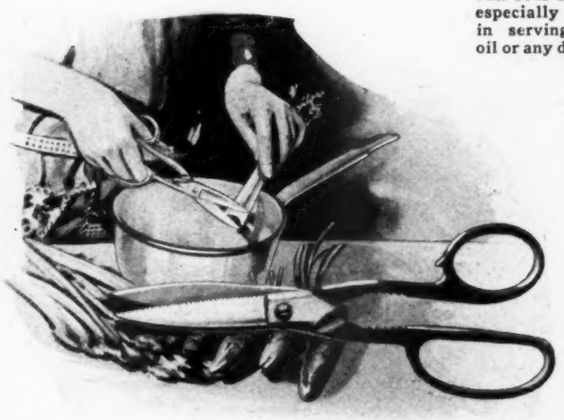
NEW TUBE HOLDER. When a tube of shaving cream or tooth paste is set in this holder, it cannot tip over and the contents are readily rolled out by twisting base

SPOON AND FORK HANDLES. Into these composition handles, paper spoons or forks are inserted for outdoor use. Handles may be used often



SIPHON BULB. Fitting the stopper, right, to a bottle containing any liquid converts it into a siphon. As the bulb is squeezed, the contents of the bottle are forced out. It is designed especially for use in serving olive oil or any dressing

KEEPS SOAP HANDY. This box, attached to wall, releases soap at a touch. Cake goes back into open top



SAW BLADE ON SCISSORS. Cutting vegetables or meats is easy with the saw-toothed scissors seen at left. The saw blade is not easily dulled. The scissors can also be used to remove the caps from all jars and bottles

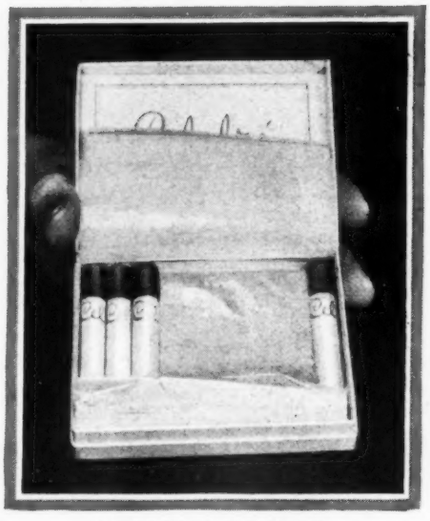
JOKES *to play on* Smokers

AN EMBARRASSING MOMENT

Several cigarettes are strung together in manner shown. Taking one, takes the whole string

A FAKE BOX OF SMOKES

With a razor blade, several cigarettes are cut into small bits and then stuck upright on a piece of cardboard that fits the box snugly. Trying to take one brings a laugh



A PERFECT ILLUSION

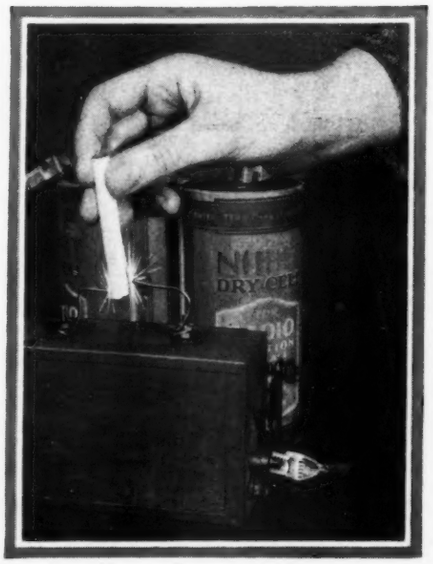
Cover the bottom of a cigarette box with tin foil and set a piece of clear glass in the top. The cigarettes look—and are—real enough to lead any one to help himself—without success

TOUCHED WITH INVISIBLE WAX

Hot wax from a burning candle is dropped on the striking surface of a matchbox and rubbed in. Naturally matches cannot be lighted on it

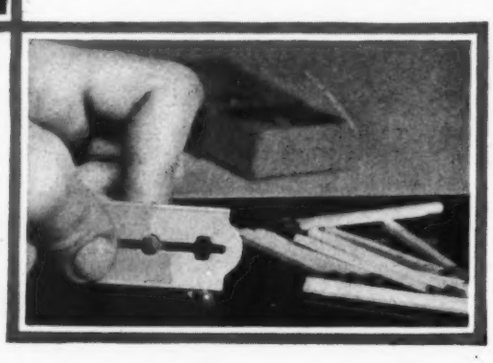
THE CIGARETTE GOES OUT

Push a piece of soft copper wire, shorter than the cigarette, through the center of the tobacco. The cigarette will not remain lighted as the wire will keep the heat so low that tobacco cannot burn



IT WON'T STAY LIGHTED

If a cigarette is held between the terminals of the ignition from an old car, the paper will be filled with microscopic holes. As a result, it will be impossible to keep the cigarette lighted



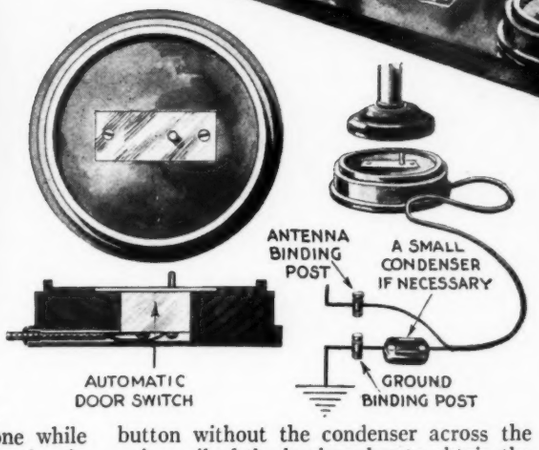
MATCHES THAT BREAK

Using a sharp razor blade, cut the match stick, close to the head, almost through and put the doctored matches back in the box. When an effort is made to strike them, the heads break off

AUTOMATIC SWITCH

Quiets Radio When Phone Is Used

Lifting the phone from the stand, right, automatically dims the radio if the stand has a door switch set in its top and connected as shown in drawing below. At left, phone table is equipped with a push button that operates the dimming circuit



MANY persons who find it virtually impossible to hear over a telephone while a radio receiver is operating in the same room resent the inconvenience of running to the radio to reduce its volume or shut it off entirely every time the phone rings.

With some wire, an ordinary doorbell button, and a small condenser, the handy man can rig a simple dimming switch with which the radio's volume can be controlled from the telephone table.

As shown in the diagrams, the push button and condenser are wired in series so that a short-circuiting connection across the antenna and ground terminals of the receiver is made when the button is pushed. The regular antenna and ground connection on the set are not altered.

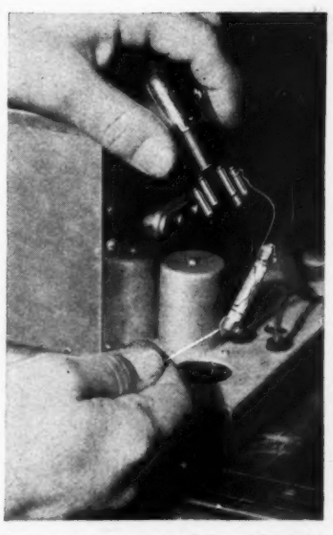
With the push-button switch open, the radio operates at its full volume. Pushing the button reduces the volume to a suitable low level. Releasing the button, returns the volume to normal.

The correct value for the condenser in the circuit can best be found by experiment, since its size will depend on conditions. More and more volume will be obtained as the capacity of the condenser is decreased. In some cases, the circuit may operate better without a condenser.

In modern sets having automatic volume control, a dimming connection of this type may have no effect whatever on the volume. If this is the case, connect the push button without the condenser across the voice coil of the loudspeaker to obtain the cut-out effect.

This same type of system can be used as the basis of a simple fully-automatic dimming switch. A low, wooden stand, turned or cut from a piece of square stock, is made to receive the base of the telephone. An automatic door switch of the type used to control a closet light is then recessed into the top surface of the stand and connected into the dimming circuit in place of the ordinary push button.

In use, the stand is placed at the back of the telephone table in such a position that the user will naturally lift the phone off to bring the mouthpiece within talking range. When the phone is on the stand, the switch button is depressed and the dimming circuit is open. When the phone is lifted, the switch button springs up, the dimming circuit is closed, and the radio's volume is decreased. Replacing the phone automatically brings the volume back to normal. As with the push button, the circuit can be used to short-circuit the antenna and ground binding posts or the speaker voice coil depending on the circuit.—GEORGE JOHNSON.



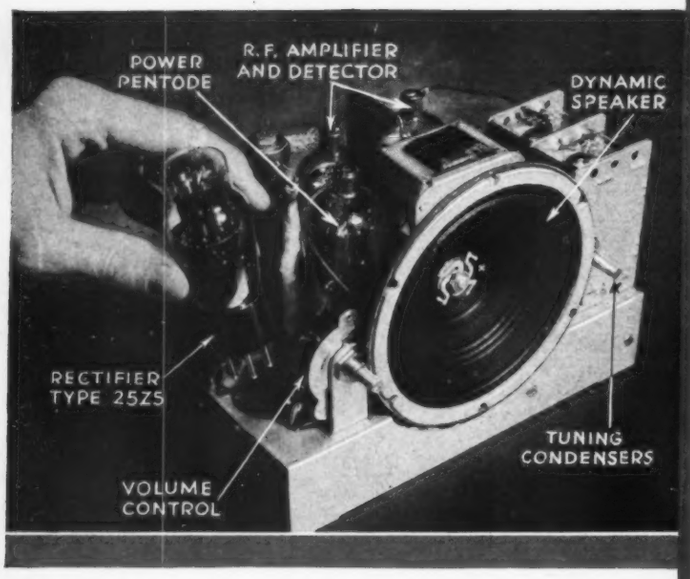
A resistance connected from the grid prong of output tube to negative B-lead is used to check radio crackles

Banning Hums—Crackles

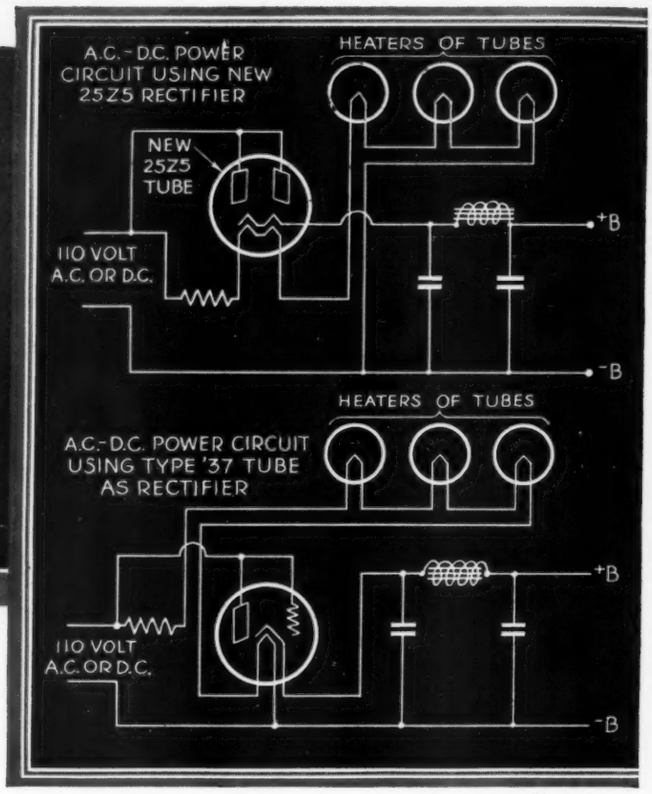
HUMS, crackles, and weird howls that develop suddenly in a radio set generally mean tube trouble. For instance, if a receiver emits a hum when the set is on, the detector tube may be at fault.

Hums, however, are not always caused by the receiver. Sometimes, the broadcasting transmitter is causing the trouble. For this reason it is always best to try the set on several stations before you waste time testing tubes and inspecting the wiring.

Your receiver may be working beautifully and suddenly develop a rapid-fire crackle or squeal. When a symptom of this kind develops, connect a resistance from the grid prong of the output tube to the negative B lead. If push-pull arrangement is used, a resistor should be connected to each tube. Start out by using a small resistance (about one megohm) and increase the value until the best results are obtained.



Chassis of midget radio receiver, removed from its tiny cabinet. At left, new 25Z5 tube which can be used as half-wave rectifier



These Novel Circuits

Tom Thumb

RADIO receivers of the future will be housed in tiny boxes no larger than a jewel case. This prophecy was made by Thomas A. Edison late in 1926.

Today, less than seven years later, Edison's prediction is a reality. Miniature receivers, small enough to be held in your hand, are the latest in radio construction. Weighing as little as six pounds, these super-midget radios are masterpieces in compact design.

When you see one of these peewee receivers, you wonder how it is possible to cram so much equipment into so small a space. The answer is careful design and the use of a compact transformerless power unit to supply the current to the tubes.

By eliminating the need of a transformer, the receiver can not only be made lighter and smaller but universal, since it can be operated on any type of current—direct or alternating. Strictly speaking, transformerless A.C.-D.C. power circuits are not new but when combined as they are with a compact receiver they allow genuine portability.

With a universal receiver, you can plug the power cord into any 110 volt socket and get reception. The activities of the set are not limited to locations having either direct or alternating current. Even an outside antenna or ground are unnecessary in most cases. A twenty-foot length of flexible, silk-covered wire serves as an antenna and, by the nature of the circuit, the set is always grounded through the power line. On some midget receivers, the antenna wire and the power cord when not in use can be stored in a small pocket at the rear of the cabinet.

Of course, in a tiny set of this type, space is at a premium. It is impossible to design them to give service and reception equal to their larger brothers. But as auxiliary receivers for the home and portable sets for the traveler and vacationist they are ideal and give satisfactory service.

How the parts are crammed into the small cabinet is shown in the photograph of the chassis and the wiring diagram. On this particular midget, a high-grade dynamic speaker is used to give good reproduction in spite of the small diameter cone.

Although many of these miniature receivers are designed along tuned radio frequency lines, there are others, a bit larger and heavier yet still much smaller than the regular mantel models, that use a five-tube superheterodyne circuit that makes use of '77, '78, and '43 tubes.

The novel A.C.-D.C. power circuits used in these midget sets should be of particular interest to the radio fan, especially to those who build their own receivers. Although some universal circuits make use of the type '37 tube as a rectifier and others employ the new 25Z5 rectifier tube, there is little difference in the wiring and either is easily constructed.

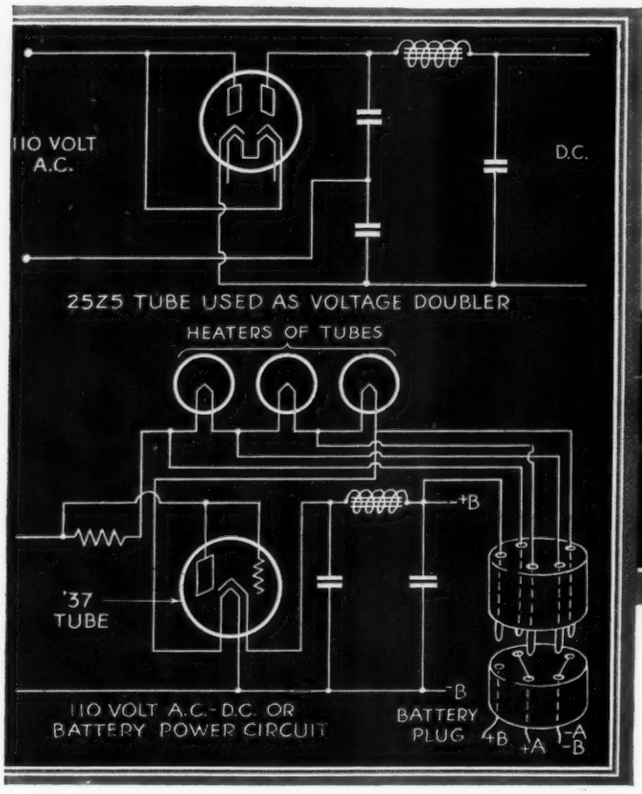
When using the '37 tube as the rectifier, the plate and grid of the tube are used as a single element. This is accomplished by soldering a short length of wire across the grid and plate terminals on the tube socket.

Here are two attractive cabinet designs, of which there are many to choose from, that house the universal midget sized receivers

Since the circuit operates without a transformer, the heaters of the tubes are connected in series and a suitable ballasting resistor is inserted to cut down the full 110 volts supplied by the power line to a usuable value. If, as in most cases, three six-volt automobile tubes ('36, '38, and '39) are used in addition to the rectifier, the resistor will have a value of approximately 300 ohms. The positive side of the filter circuit leads off from the cathode of the rectifier as shown.

When a circuit of this type is connected into an alternating current supply of 110 volts, either twenty-five or sixty cycle, the heaters of the tubes receive their current direct while the B-current passes through the tube, is rectified, and filtered.

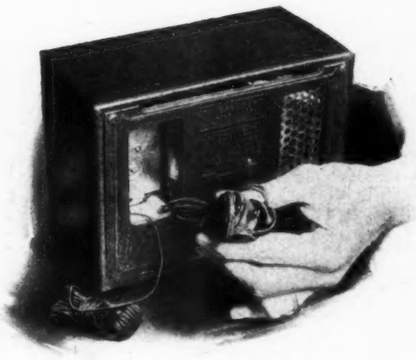
More or less the same thing takes place when the power



This thoroughly portable receiver is not only small and light but it is designed to work on either direct or alternating current

Are the Secrets of New Radio Sets

By
GEORGE H. WALTZ, JR.



This pocket, at the rear of most tiny sets of the universal design, receives the twenty-foot antenna end also input cord

supply is 110 volts direct current. Of course, there is no change when the direct current passes through the rectifier and filter other than a slight filtering action.

However, to operate on 110 volts direct current, any universal power circuit of this type must be connected correctly for polarity. The plate and grid of the rectifier must be connected into the positive side of the line. If the reverse connection is made, the tube heaters will light up as usual but no current will be passed to the plates, grids, and screen grids of the other tubes. Aside from failing to work, a wrong connection in no way harms the tubes or the circuit.

The circuit using the new type 25Z5 rectifier in place of the '37 differs only slightly from the one just described. The connections to the tube are, of course, different.

In reality, the 25Z5 rectifier is two independent half-wave tubes within a single bulb. It is provided with two plates, two separate cathodes, and two series connected heaters that operate on twenty-five volts. The real advantage of the tube is that it can be used in transformerless A.C. circuits as a voltage doubler. Its double plates and cathodes make it possible to connect the tube in such a way that it will deliver approximately twice the regular output of a half-wave tube. The method of connecting the 25Z5 as a voltage doubler is given in the drawings.

However, the voltage doubling characteristic of the new tube is not the feature that makes it valuable as a rectifier for universal power circuits. Its high-voltage heater makes it particularly suitable on another score. By requiring twenty-five volts, it makes it possible to reduce the value of the ballasting resistor connected in series with the tube heaters.

In an A.C.-D.C. circuit, the 25Z5 is used with its twin plates and cathodes connected in series as shown. The two plates function as the input electrode and the two cathodes feed the filter circuit. In reality it operates as an ordinary half-wave rectifier.

A receiver having a universal power circuit also can be wired so that it will operate on batteries. Arrangements of this type make the midget even more versatile since it then can be used in motor boats, automobiles, and summer cottages where 110 volts is not obtainable.

This added feature is obtained by the connections shown in the drawings. The wiring is so arranged that plugging in the batteries automatically changes the heaters of the tubes from series to parallel and makes the necessary B-current connections. In this case, the rectifier is left out of the active circuit. The connection plug is used as a switch and besides disconnecting the filament current from the circuit it also excludes the B battery.

Through the use of an external ballasting resistor of the right value to cut down the voltage to 110, these circuits also can be used on a 220 volt A. C. line without altering the internal connections. The external resistor should be wire wound.

As in any receiver whose circuit is grounded through the power line, the antenna lead enters the receiver circuit through a small capacity condenser (about .002 mfd.). This serves as a precaution against a possible short circuit.

Due to the internal ballasting resistor used in these circuits, sets of this type may tend to heat up when in operation for any length of time. Many manufacturers of midget sets warn users not to place the cabinet in a confined space or operate the receiver on a shelf over a radiator. Some midgets develop heat equivalent to that given off by a thirty watt electric lamp.

However, to avoid any difficulties from overheating, the ballasting resistor often is made a component part of the power cord which leads to the electric light plug. The resistance is carefully wound around the insulated wires and a silk and asbestos covering is formed over the entire unit.

"Looks fine," said Gus as he held the bottle to the light. "But looks don't mean much."

Save Oil *and* Pay *for* Repairs

BY MARTIN BUNN

GUS WILSON was spending his holiday battling the weeds that threatened his garden. Paul Mathews, next door neighbor, paused on the way to his garage and waved a greeting.

"I've got to get the oil changed in my car," he announced. "I think I'll try a place out on the Pike where they sell it for half the regular price."

"What oil is it?" Gus inquired, jerking at a particularly stubborn weed.

"Search me. Some new brand, I think, and it looks good. I know a fellow who's been using it for several months and he swears by it."

"That's possible," the grizzled auto mechanic agreed with a smile. "It takes a while for the effects of bad oil to show. Say, if you can wait till I change my clothes, I'll run out with you and take a look at this bargain stuff."

An hour later the two men pulled up at a small roadside gas station. A grease-smeared individual shuffled toward the car in which they sat.

"I want the oil changed and I thought I'd try some of that special low-priced stuff," Mathews told him.

"Sorry, boss, but we don't change oil," said the man. "Can't afford to at the price. You can buy it here and change it yourself."

"What kind of oil is it?" asked Gus.

"Special brand, mister. Got an agreement with the producers so's I can sell it cheap. Good oil too," he said, lifting a bottle from a low stand beside a gas pump. "Look at that color."

"Looks fine," grinned Gus, taking the bottle and holding it to the light, "only looks don't mean much with oil."

"Who says so?" demanded the man. "Any time you see oil flow like this, you can bet it's good. It's got good body, see? Stick your finger in and feel of it," he invited, unscrewing the cap. "I've got it in all the regular grades, too, from the lightest to the heaviest."

"You can feel an oil till you wear out your fingers," insisted Gus, "and not find out a thing about its quality. The expert isn't born yet who can tell the quality of an oil by looks or feel."

"Say, are you telling me?" the man growled. "I've been selling oil for years and I guess I know what I'm talking about."

"I can see that," Gus replied good-naturedly. "Well, we've got to make another stop. We'll pick up the oil on our way back."

Somewhat bewildered, Mathews stepped on the starter. "What's the idea?" he demanded as the car gained speed. "We haven't any other stops to make."

"Yes, we have," corrected Gus. "I've got to stop off at the Model Garage and you're coming, too, and learn something."

"But what about my oil?"

"Listen, Paul," said Gus seriously, "that oil's no good. If it was, don't you suppose all the other gas stations would be selling it?"

"How do you know it isn't any good?" asked Mathews sharply. "You said yourself you can't tell anything about an oil by looking at it."

"No, but you can tell a lot by looking at the guy who sells it. You can't get good oil at that price. It takes a high-grade oil to stand the gaff in a motor. No cheap mixture will do the trick."

"But he's got it in all the different grades of thickness just like any other oil," Mathews argued.

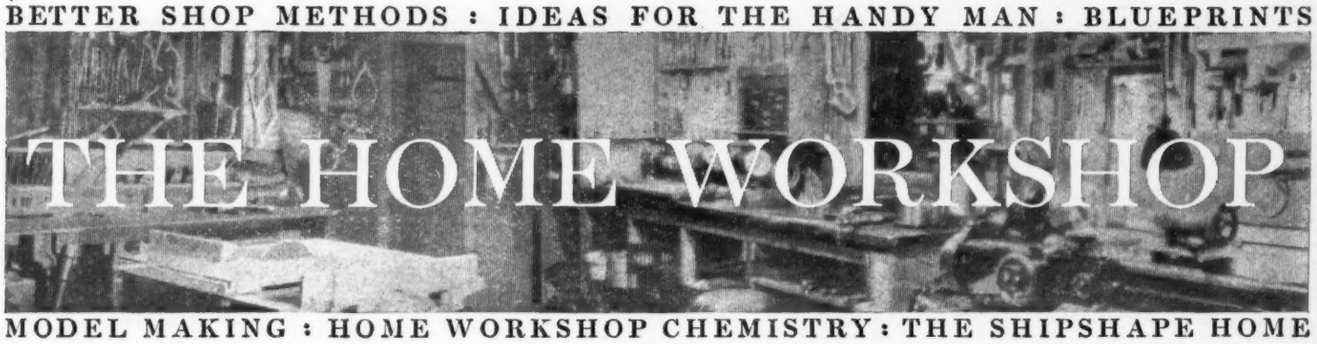
"Sure, but that doesn't mean anything, either. The thickness or viscosity of an oil is only an indication of its body at a certain temperature. The thickness of motor oils is graded by numbers—from ten for the lightest to seventy for the heaviest. But those ratings have nothing to do with quality. The numbers are just like shirt sizes. All they tell you is whether you have a fit. Quality is something else again."

"Well, I don't see why they can't produce an oil that will last longer," said Mathews. "Changing it so often—"

"Is a darned nuisance, I admit," Gus finished for him. "But that's a job I'm afraid you can't dodge. No matter how perfect the oil, it's bound to be thinned after a while by the unburned gasoline, water vapor, and road dust in a motor. And you can't lubricate a high-grade piece of machinery with that sort of muck. Some of the oil just disappears too. Right now, for example, you're driving this *(Continued on page 93)*

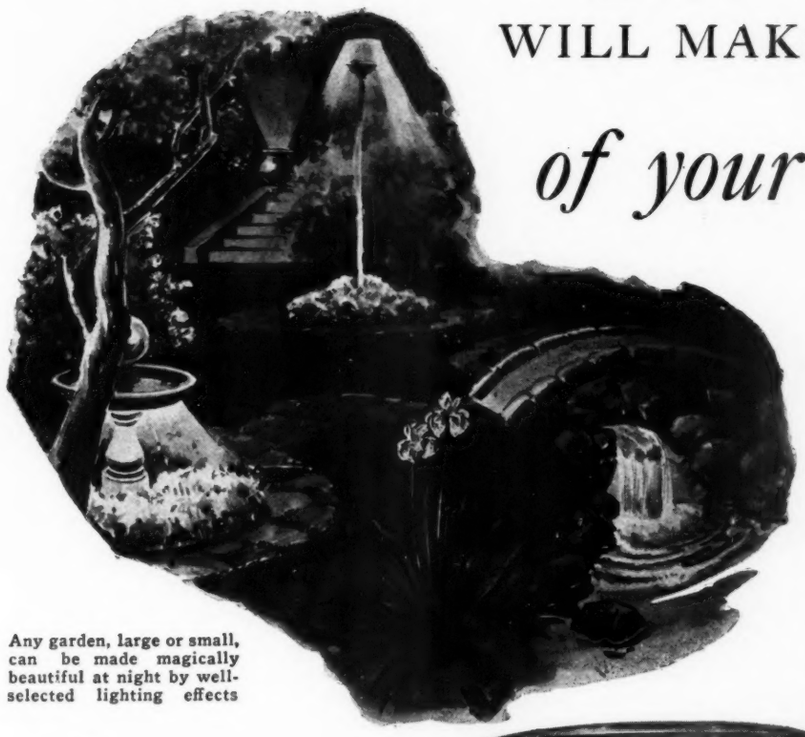
Gus says:

Next time you have an urge to jam your accelerator to the floor, remember that jumping a car's speed from forty to sixty just about doubles your driving costs. Besides, a car doing sixty miles an hour has about the same destructive force as a two-ton weight dropped from the top of a building 125 feet high.



Simple Lighting Stunts

WILL MAKE A FAIRYLAND *of your Garden*



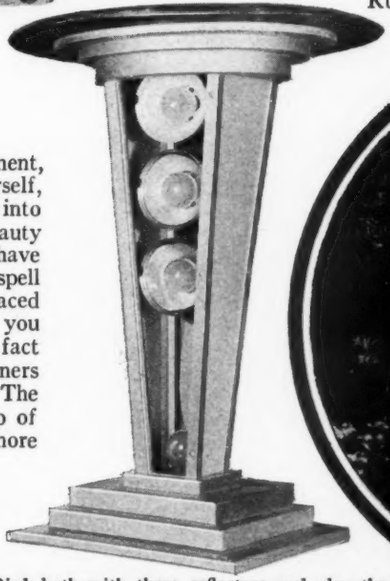
Any garden, large or small, can be made magically beautiful at night by well-selected lighting effects

By
WALTER E. BURTON

WITH a few dollars' worth of equipment, much of which you can make yourself, you can transform your flower garden into a nighttime fairyland that will rival in beauty anything the day has to offer. Until you have tried it, you cannot appreciate the magical spell cast by a few electric lamps, when properly placed for the most artistic effect. Some of them, if you wish, may be equipped with color screens. One fact that lighting engineers and landscape gardeners have learned is greatly to your advantage. The lighting must not be overdone. A small lamp of from 6 to 30 watts often will produce a more pleasing effect than one of larger size.

One of the simplest ways of lighting a garden is to suspend a flood-light unit in a position where it will throw its rays over much of the planted area. The gable of a nearby house, the top of a flagpole, the branches of a tall tree, or the roof of a garage are among the places such a reflector can be mounted. You can employ a commercial type of unit, such as one of the small handy flood lights costing less than $6, or construct your own from a 25-cent aluminum mixing bowl, a screw-ring porcelain socket, and a few odds and ends. Two of the photographs on page 58 show how easy it is to make a reflector. Simply cut a hole in the bottom of the bowl large enough to receive the socket and fasten some kind of bracket or base to the bowl so that it can be mounted. Then insert a bulb rated at 100 watts or so, depending on the area to be covered and the intensity of the light desired.

If the reflector is to be exposed to rain or other moisture, you can use a waterproof soft rubber socket; or pour sealing wax around the base of the lamp, if an ordinary porcelain socket is used. Rubber gaskets for producing a water-tight fit



Bird bath with three reflectors and also three small colored bulbs. *At right:* When illuminated

between bulb and socket can also be purchased.

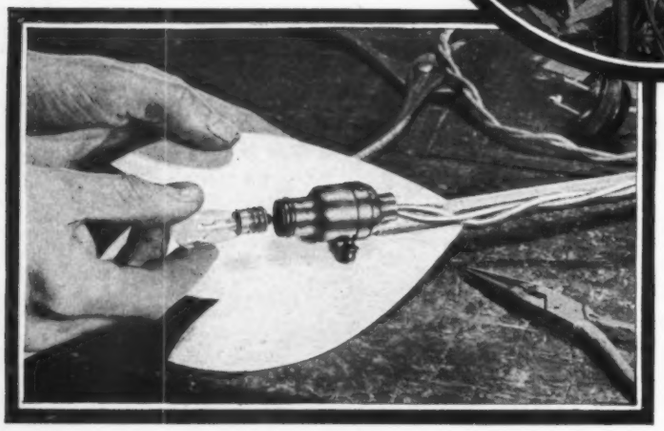
For special effects, color screens can be placed in front of the reflector. Colored cellophane, glass, or special materials designed for show-window use are suitable if properly protected from the weather. The cellophane can be held in a wire or sheet metal ring attached to the aluminum bowl by screws.

You may desire a very high intensity of light over your garden during parties or for other relatively short periods. One of the cheapest ways to obtain this is to use photoflood lamps. These lamps, costing 35 cents each, consume about 300 watts, produce illumination equal to a 750-watt standard lamp, and when burned at 115 volts will last two hours.

Ordinarily it is more desirable to use a number of smaller, well-placed units rather than one or two large flood lights. Small 10-cent aluminum mixing bowls and lamps of from 15 to 30 watts can be used to make lighting units that will cast a soft, pleasing glow over a tree, shrub, flower bed, or piece of garden furniture. Such reflectors may be equipped with sharp spikes so they can be placed anywhere on the ground, and they can be moved about and directed as desired.

Reflector made from a small aluminum mixing bowl and a screw-ring socket. Such a unit may be waterproofed by using melted sealing wax

The outlay for making this small flood-light reflector was less than 40 cents. The unit is set up wherever desired in the garden simply by pushing the pointed end of the support into the ground



Lamp and aluminum shield. A 6-watt 110-volt lamp and a brass candelabra socket are shown, but other miniature equipment, such as bakelite pigtail sockets and intermediate base lamps, may be used. The socket is held by a bolt passing through the round wooden stem and engaging the small set-screw hole

In illuminating trees, it has been found that a single source of light often produces a harsh effect. This can be eliminated by using two reflectors placed so that one furnishes a general illumination while the other breaks up the monotony by providing high-lights. The best color of light for a tree, where the green foliage is to be shown in its natural hue, is a special light green or bluish-green. Other colors can be used for producing special effects, for the leaves reflect several hues other than green.

Against a background of general illumination provided by small reflector units, you can accentuate points of special interest by means of small bulbs and suitable shields. Thus, a choice group or border of tulips can be brought into prominence by placing a 5-, 6-, or 10-watt lamp close to them and keeping its direct rays from the eyes of the observers by means of simple metal shields mounted on pointed wood or metal standards, as shown in two of the illustrations on this page.

These shields, which you can make without difficulty, may be in the form of flowers, birds, or other decorative objects. They are, of course, gaily painted on the front side and provided with a reflecting surface on the reverse side painted white or aluminum.

A little more elaborate set-up consists of a cut-out bird with its wing mounted less than ½ in. in front of its body, as illustrated at the bottom of page 59. The rear surface of the wing is painted white, and the lamp placed so that light coming through a hole will be reflected from the wing over the remainder of the body. Sheet aluminum can be used for the cut-outs, and the front surfaces made "satiny" with a strong lye solution.

A novel way of calling attention to particular flower groupings is to use a translucent screen, such as a sheet of draftsman's tracing cloth held in a frame of pleasing shape. Place the screen in front of a plant and mount a suitably colored lamp behind it so that the shadow images of the flowers are thrown on the screen to make an attractive living picture. If two light sources of different colors are used, the shadows will be in various and striking hues.

If it is lighted properly, the bird bath continues to hold the center of the garden stage at night as well as in the daytime. Birds will not be bathing at night, and the bath may therefore be treated entirely as an ornament or lighting fixture. A few concealed lamps placed about the lower surface of the bowl will illuminate surrounding flowers. An ordinary bath can be brought into prominence by means of one or two flood-light units directed toward it.

An ingenious method of employing the bird bath to fullest advantage at night is to make it a housing for several reflectors which cast their beams on nearby parts of the garden. A particularly effective arrangement of this kind is shown in the illustrations at the bottom of page 57.

To make an illuminated bird bath of this type, construct a hollow pedestal, a square form being simplest. Make a framework of metal or wood, and panel three sides with some translucent material such as flashed opal glass. Cover the fourth side with clear glass having a

Corner of an informal garden with trellis and flower beds illuminated by the equipment shown at the right. The lights give a soft, natural effect

pebbled texture that will diffuse the light evenly. Inside the pedestal, place two or three small flood-lighting units with mixing-bowl reflectors. Also, include two or three colored lamps for lighting the glass. Mount a conventional basin on top.

Still another bird-bath stunt is to mount a small crystal ball or statue above the basin, and place a lamp or two below it, under the pan if necessary, allowing the illumination to come through a specially constructed water-tight aperture from beneath.

Silvered reflecting balls are popular garden ornaments. They become doubly attractive when two small spotlights or flood lights, casting different colored beams, are directed toward them.

Speaking of spotlights, you can rig up an inexpensive fixture for throwing a concentrated beam of light by mounting a socket inside a length of stovepipe and fastening a plano-convex lens over one end. Use a clear glass bulb for maximum concentration. Instead of this, you can employ cheap automobile spotlights operated by a toy transformer.

The garden pool can be lighted in an endless number of ways. A simple flood light, throwing its beams on the rippled surface of the water, often is enough, particularly if the beam is colored. Another method is to submerge and preferably conceal one or more bulbs beneath the surface, where their glow will be diffused throughout the pool. You can do this by screwing the lamps into waterproof sockets and sealing them with wax, as already described.

If you are building a pool, you will be wise to provide for underwater lighting by the inclusion of one or two glass windows in the wall, behind which lamps can be placed. The same is true of miniature waterfalls or fountains. The light should be placed where experiment shows it will give the best effect. By using several colors of light, you can produce an unlimited variety of effects in pools, waterfalls, and fountains.

Opaque shield for localizing the light on a special plant or bed of flowers

Among other pieces of lighting equipment you can make or purchase for use in your garden are portable work lights having pointed standards which can be stuck any place; portable, ornamental lanterns on standards; Christmas tree miniature lamps, which can be used for producing individual spots of light or can be inserted into the necks of inflated rubber balloons for forming striking garden party lanterns; lamps concealed beneath the caps of stone or concrete walls, under copings of stone balustrades, in garden trellises, chairs, and other furniture; bird houses having small lamps beneath the eaves or under the bottom for illuminating surrounding flower beds; brightly painted metal flowers that can be placed in the center of flower beds, with lamps concealed beneath the metal petals; and troughs, in two sections, that can be mounted about tree trunks for illuminating the foliage above.

The list could be prolonged indefinitely. The possible effects are limited only by the garden owner's ingenuity or resources. The beginner in garden lighting will look in vain to electrical supply dealers for convenient kits. Therefore, lighting experts at Nela Park, Cleveland, Ohio, have suggested a list of equipment which will be found convenient for the average sized garden. It includes the following:

Materials for lighting a garden of moderate size. Their value is from $15 to $18. The outfit includes four small flood-light projectors, one larger projector, and seven sockets for holding intermediate base lamps

Photos courtesy of General Electric Company

A weatherproof string of seven multiple sockets for intermediate base lamps; 6- or 10-watt lamps to fit the sockets; half a dozen opaque metal shields with lamp-socket clips at the rear; a metal bird with wing set forward; four small flood-light projectors and one larger projector; four bulbs of 40-watt size, one 100- or 150-watt lamp for the large reflector, and waterproof flexible cable.

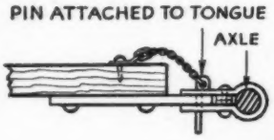
TINFOIL REPAIRS WORN INSTRUMENT THREADS

When the threads of any small tool or precision instrument have become worn or partly stripped, it is an easy matter to make a reasonably permanent and accurate repair by pressing into the threads on the inside of the nut a small strip of tinfoil. After the foil has been pressed as deeply as possible into the crevices of the threads, it should be gently removed, care being taken not to spoil its shape, and given a coating of strong shellac or glue. It should then be replaced with equal care until the shellac or glue is thoroughly dry.

In instruments or apparatus of large diameter, such as the object lens of a pair of field glasses, four shorter strips may be placed at equal distances around the inside.—Forrest L. Bezanson.

TOY TRAILER FOR USE WITH TRICYCLE

Hooking up the trailer (left), and a drawing of the coupled joint (right)

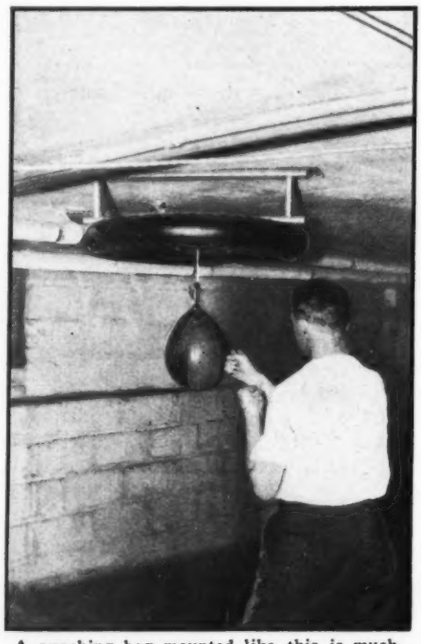


A BOY can get much more fun out of a tricycle if it has a detachable trailer that can be used for playing delivery man, truck driver, or anything else his fancy pleases. To build such a trailer is relatively easy, and it can be painted to look like a factory job. Note in the accompanying photograph the businesslike look given by the heavy tongue and by the wings above the wagon box. The tongue has a strap iron tip with a hole in it, and this part fits into a U-shaped attachment that is bent around the rear axle of the tricycle and riveted. This arrangement is made clear in the drawing above. An iron pin is slipped through the holes in the U-shaped piece and the tongue when it is desired to attach the trailer to the tricycle. The pin is chained to the tongue so that there will be no danger of its becoming lost.—D. A. BUTLER.

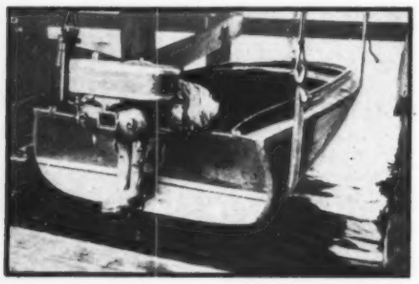
PUNCHING BAG PLATFORM MADE FROM OLD TIRE

WHILE hunting for something with which to make a punching bag platform, I came across an old automobile tire casing. I stuffed this tightly with old rags, taped it to hold them in, and mounted it on a wooden framework, which was attached to the basement ceiling and braced to prevent vibration, as shown in the accompanying illustration. That part of the framework immediately above the tire is shaped like a cross, and the punching bag cord is suspended from its center.

It would have been still better if an inflated tire or a disk wheel with the tire in place could have been used. Such a platform is heavier and quieter than one constructed of wood, and it costs practically nothing.—P. G. BERNHOLZ.



A punching bag mounted like this is much quieter than if an all wooden platform is used



SLING FOR MOTORBOAT

OUTBOARD motor enthusiasts who seek some method of bringing their boats out of the water to be stored temporarily under docks without damage to the thin hulls will find firemen's canvas hose the answer to their problems. Rigged up as shown in the photograph above, the boat will be safe from damage. Old hose can usually be obtained at your local fire station at low cost.—HARRY MAUCK, JR.

RULING PEN AIDS MODEL WORK

MODELS, especially very small ones like the liner *Manhattan* (P. S. M., Feb. '33, p. 63) can be painted more easily if the fine lines are made with a draftsman's ruling pen.—CHARLES E. O'MALLEY.

OLD AUTO PARTS FORM UNIQUE WIND BELL

THE melodious wind bell shown in the photograph above was constructed from parts of wrecked automobiles. It makes an attractive ornament for the garden, summer house, or porch, and its round, bell-like tone—like the chime of distant temple bells—is appealingly soft, mellow, and rich.

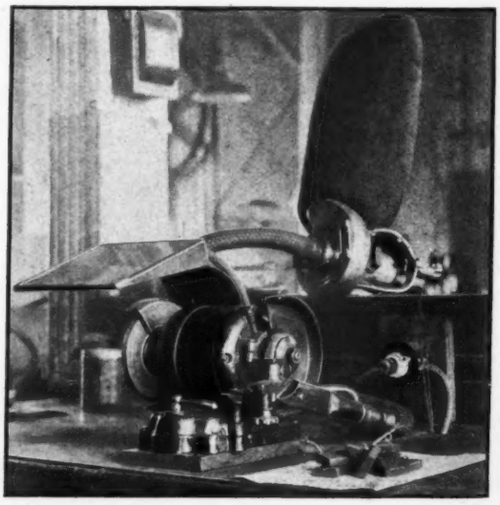
The hammered and fluted canopy originally saw service as the reflector of a head lamp. Three of the "bells" are old brass carburetor bowls; the fourth and tallest one served as the inner compartment of a vacuum tank.

The clapper is a turned hardwood knob that formerly did duty as a drawer pull. It is of such size as nearly to fill the space between the gongs. The wind vane on the bottom of the central cord is an odd scrap of thin sheet brass trimmed to shape and given a hammered effect. A little oil color applied with a spray gun gave the completed wind bell an antique appearance.—R. GERALD BULLARD.

COLLECTING DUST FROM BENCH GRINDER

AN OLD vacuum cleaner can be easily converted into a dust collector for a bench grinder. The cleaner may be placed under the bench, on the wall, or in any convenient location. The hose is then brought in behind the grinding wheel, and one of the fittings usually supplied with vacuum cleaners is fastened a little below the wheel. If no such fitting is available, one can be made from a small piece of sheet metal. With this arrangement, all the dust from the grinding wheel is instantly removed.

The grinder illustrated is used for grinding electric motor brushes. These are made of soft carbon and give off a large cloud of dust which, if inhaled by the operator, would be certain to cause violent sneezing.—H. F. LORING.



An old vacuum cleaner arranged to collect dust behind a bench grinder used for electric motor brushes

Jig-Saw *Short Cuts*

How to make high-grade puzzles—Methods I learned in building up a paying business

By W. L. Faurot

Author of *The Art of Whittling*

Faurot signs his name in wood—an idea to remember when making up puzzles for gifts or as Christmas or birthday cards

EACH operation in making a really fine jig-saw puzzle requires extreme care and cleanliness. No matter how quickly the vogue for cheap cardboard puzzles may pass, there will always be some demand for high-grade interlocking wooden puzzles; and from the standpoint of the home worker, picture puzzles are among the most desirable and inexpensive gifts.

Preparing the Panel. Use 3/16-in. basswood plywood. (Panels sold as ⅛ in. thick by some manufacturers are almost as thick as the 3/16-in. panels of other manufacturers and are quite satisfactory.) Allow ¼ in. or more in wood dimension for expansion of print and trim. White casein glue, commonly designated as No. 2, is admirable. Mix thick and spread evenly and thin with a stiff-bristled brush to the wood surface *only*. Let dry until tacky and apply the print. Press and smooth with a clean cloth, rubbing from center to edges, or cover with paper and roll with a print roller. There should be no air pockets. Be sure the edges and corners are firmly bonded. Dry under pressure. This method eliminates much of the warping sometimes caused by other commonly used systems of gluing.

If paste is to be used, the panels should first be sized with thin hide glue. Soak flake glue in cold water until dissolved, then bring to a boil, skim, and allow to cool. Cover the entire top surface of the panels. For the paste itself, add dry powdered paper hanger's paste to the thin, liquid glue and stir thoroughly to a creamy consistency. Spread the paste thinly on the back of the print first. This will allow the paper to expand slightly while the wood surface is being pasted, eliminating stretch and consequent wrinkling which occurs when a dry print is placed upon a paste covered panel. In the simpler and preferable casein process, the glue is sticky and contains very little moisture to expand the paper. Paste and glue should be mixed fresh each time.

Roll the print until bubbles and wrinkles have been smoothed. Be careful not to get any glue on the picture surface, and clean the panel edges. Lay the panel face down on a smooth, flat surface, and weight it evenly. If more than one panel is mounted at one time, stack them, placing paper between each pair. Should a bit of paste remain on any picture face, it will adhere to this paper instead of the back of the next panel and may be soaked off without harm to the print. Glue, however, is not so easy to remove and every precaution should be taken to keep it off the print.

When thoroughly dry, trim the edges with the

(Continued on page 85)

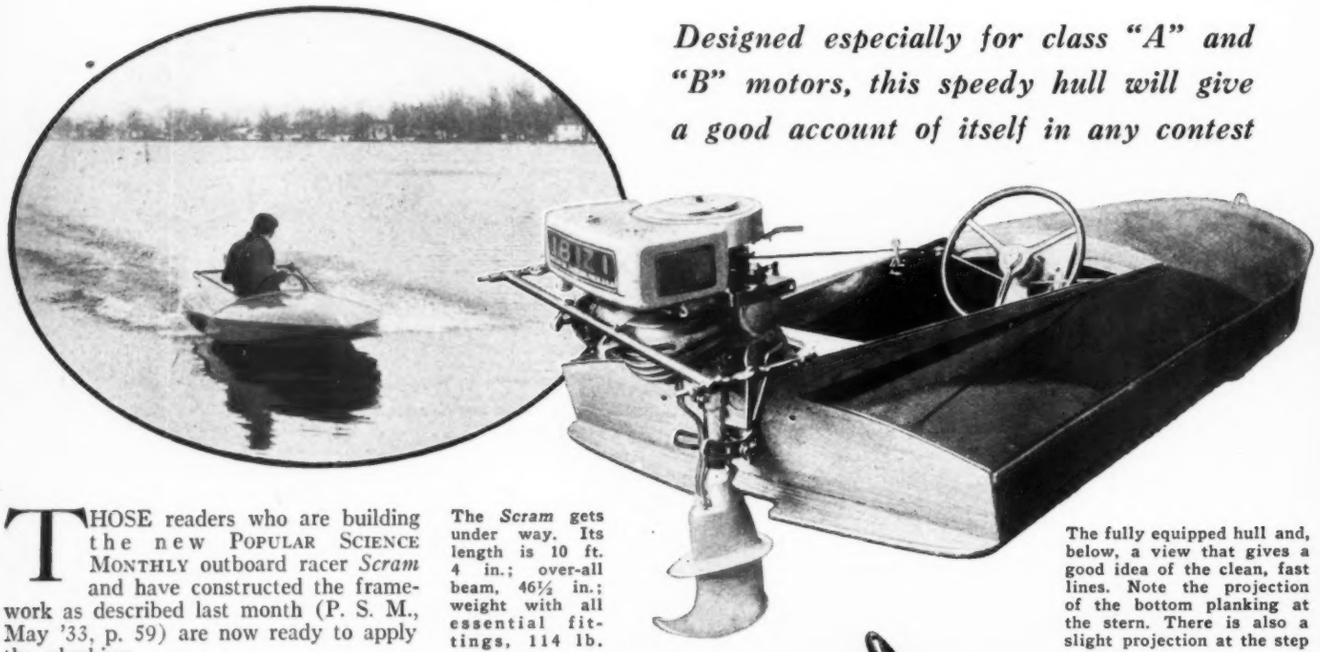
The edges of a puzzle may be trimmed with a sharp, fine-set block plane

Much time can be saved if the separate pieces are put together on a sloping stand just as soon as they have been sawed

Patterns for figure pieces can be prepared in quantities with a hectograph and fastened on the picture with rubber cement as shown above. After the puzzle has been sawed up, the patterns are stripped off neatly as at the right

Planking *and* Finishing

Designed especially for class "A" and "B" motors, this speedy hull will give a good account of itself in any contest



The *Scram* gets under way. Its length is 10 ft. 4 in.; over-all beam, 46½ in.; weight with all essential fittings, 114 lb.

The fully equipped hull and, below, a view that gives a good idea of the clean, fast lines. Note the projection of the bottom planking at the stern. There is also a slight projection at the step

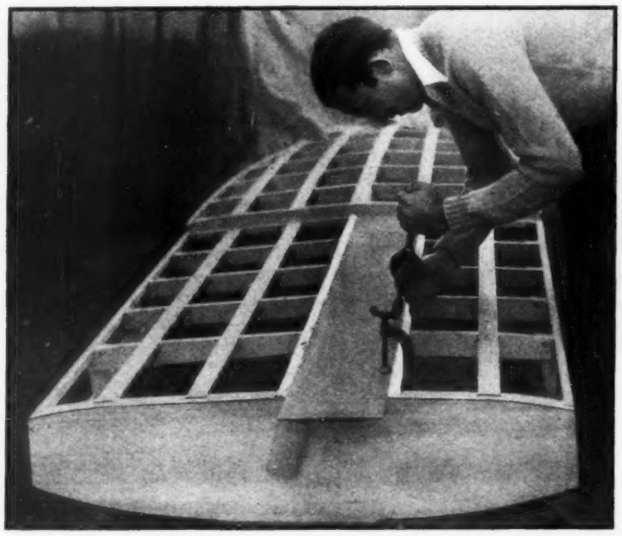
THOSE readers who are building the new POPULAR SCIENCE MONTHLY outboard racer *Scram* and have constructed the framework as described last month (P. S. M., May '33, p. 59) are now ready to apply the planking.

The side planking material is clamped in place, marked to shape, removed, and sawn out. Before fastening the planks, coat the chines, transom, and step with aviation glue. The shaped planks are clamped in place and fastened with 1-in. No. 8 screws spaced about 2 in. apart. All screws are flathead unless otherwise mentioned. Use a double row of screws at the transom. Copper clout nails ¾ in. long are used to secure the planks to the inwale. After planing the plank edges smooth, proceed to notch in the battens for the bottom planking.

The batten notches are cut into the after step section first. As the bottom planking will be about 7¾ in. wide, cut out one of the after step planks the correct width and, using it as a template, lay the edge of the plank on the center of the keel. Mark the frames along the outside edge. Move the plank over and repeat the process for the rest of the battens. The ¼ by 1¾ in. batten material is carefully notched flush into the frames so that half of the batten is on each side of the plank mark just made. The plank edges will then meet in the center of the batten.

The battens are notched into the forward plane in like manner. Notch the battens in carefully, as the smoothness of the finished bottom depends upon the accuracy with which this job is done. Screw the battens to the frames with one 1-in. No. 6 screw to each joint. The after ends of the forward battens are notched halfway into the step as shown in one of the sketches published last month.

The planking is applied next to the after step section. Plank from the keel out to the chine, alternating with a plank on one side of the keel, then one on the other side. Before fastening the planking and as the work progresses, coat the keel, battens, chines, transom, plank edges, and step liberally with aviation glue and lay strips of muslin on the glued surface. A light coat of glue is then applied to the cloth. When the planking is fastened in place, the glue squeezes through and makes a thoroughly water-tight joint. Remove excess glue with gasoline or turpentine.



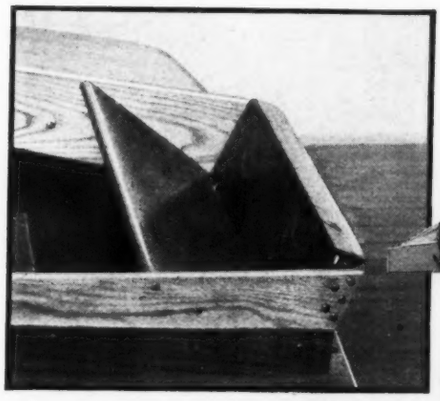
The bottom with battens notched in place ready for planking. Aviation glue and strips of cloth help keep the joints tight

Fasten the planks to the keel, chines, step, and transom with 1-in. No. 6 screws spaced about 2 in. apart. Nail the planks to the battens with ¾-in. copper clout nails. A lead hole is first drilled and the nail inserted; then, while holding an iron on the underside of the batten, drive the nail home and clinch it.

The two forward planks next to the keel will require some fitting. Clamp one 8-in. plank in place. The after and forward edges of the plank at the step and stem will meet in the center of the keel, while toward the middle the plank will overlap the center of the keel. Draw a line across at every frame and mark frames along outside edge of plank. Remove plank and measure each frame from keel center line to the outside mark. Transfer measurements to the plank, spring a light batten around the marks to connect them up, and mark and saw to shape. The planking at the step projects 1½ in. and at the transom 3¾ in., as shown in the drawings last month. When the hull is

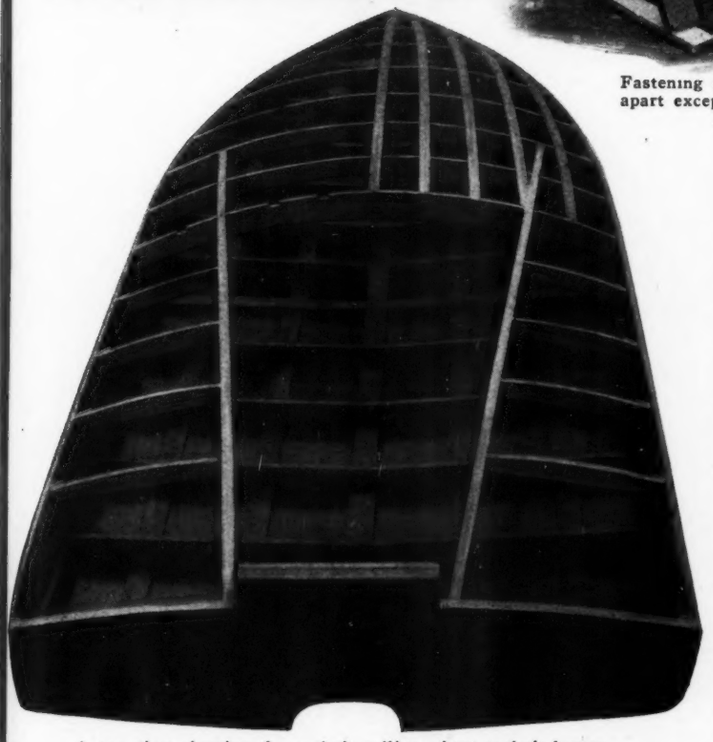
our new Outboard Racer

By William Jackson



At the left is shown the combination drip board and transom hook. It is screwed to the coaming, and the lower end is well fastened to the motor board

Fastening one of the side planks. It is held with screws spaced about 2 in. apart except at the inwale, where it is secured with ¾-in. copper clout nails



A top view showing the cockpit railing, short cockpit beams, and deck battens, which are notched only into the No. 7 beam

planked, remove it from the form and sand the bottom.

The transom knee is sawn to shape and attached to the transom with three 2½-in. No. 8 screws. The knee is secured to the keel with three 1¾-in. screws, driven through from the keel. Fill all screw holes with a plastic wood composition or similar compound, then use coarse sandpaper and finish with fine sandpaper, rubbing with the grain.

The deck beams are sawn out and fastened to their respective side-frame members with one 1½-in. No. 8 screw to each joint. Drill lead holes for screws and afterwards saw off the projecting ends.

The cockpit railing is now fitted and fastened to the transom. Allow ¼ in. separation between the edge of the motor board and the railing for the coaming. Fasten the end of the railing to the transom with one 1¾-in. screw. The railing is notched flush with beams Nos. 5, 6, and 7 and fastened with one 1½-in. No. 8 screw to each joint.

With the cockpit railing in place, it is an easy matter to measure for the cockpit beams. These are cut with a ½-in. camber from the inwale to the railing. Fasten the cockpit beams to the railing and the frame side members with 1½-in. No. 8 screws.

The deck battens are now fastened. These are curved toward the bow so that the completed deck presents a gracefully rounded contour. The plans published last month indicate the correct location of the battens. Only beam No. 7 is notched for the battens. The deck battens rest upon the remaining beams and are fastened to each with one 1-in. No. 6 screw. The ends of the battens are butted flush against the inwale and secured with one 1-in. No. 6 screw driven through from the outside. The forward end of the center deck batten is notched flush into the stem and fastened with two 1-in. No. 6 screws. Three coats of varnish are now applied to the inside.

The edges of the planking along the inwale are planed evenly, and the muslin decking is applied. This is stretched smoothly over the battens and tacked along outside edge of planking at sheer and beam No. 7 with ⅜-in. tacks. When the cloth has been stretched smoothly but not too tight, four coats of nitrate wing dope are applied. The surface is sanded lightly between coats, and a half-hour interval allowed for drying.

The ⅛-in. plywood cockpit decking is now sawn to shape and attached to the cockpit beams, railing, transom, and sheer with 1-in. No. 6 screws spaced about 4 in. apart. The end of the cockpit decking may be cut square with beam No. 7 or rounded off as shown on page 62. If ⅛-in. plywood is unavailable, ¼-in. planking may be applied in two pieces. The seam or edges are secured by notching a ¼ by 1 in. batten into the cockpit beams and nailing the edge of the cockpit decking to the battens with ¾-in. copper clout nails.

The side of the transom and motor board, above the railing, is beveled to allow the ¼-in. coaming to fit evenly. The forward end of the coaming is fitted against beam No. 7 so that ⅜ in. projects above the beam. The after end is fitted so that, above the cockpit decking, it fits even with the outer edge of the transom; and below the decking it should fit even with the inner side of the transom. Fasten the coaming to the transom and railing with 1-in. No. 6 screws.

The cockpit end piece that covers beam No. 7 is sawn to shape and fastened with four 1-in. No. 6 screws. The end piece projects ⅜ in. above the deck. The projecting ends of the bottom planking at the transom and step are sawn to shape as indicated on the plans (May issue, p. 60). The projection at the transom is reënforced with a ¼-in. filler piece. This is fitted, glued, and securely fastened to the plank projections with ¾-in. copper clout nails. A circular well opening is cut out for the motor as the drawings show.

The combined *(Continued on page 82)*

Model of Old-Time Fireplace Forms Novel Cigarette Container

RARELY will you find a cigarette container as novel and picturesque in design as the one illustrated, which is an exact model of a New England fireplace.

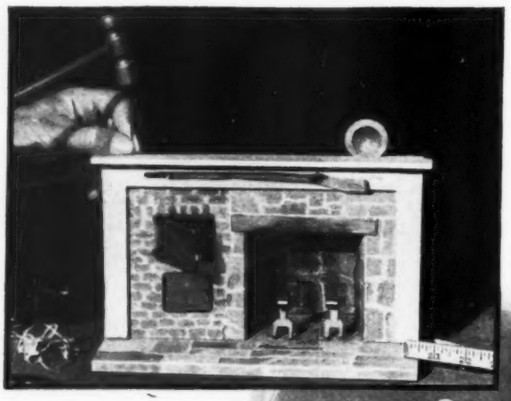
The base is ½ in. thick white pine, 5¾ by 10 in. The mantel is made of ¾ in. wide strips of cigar box wood glued to a piece of fiber wall board 6 in. high and 10 in. long. The fireplace opening, which is 3¾ by 3¾ in. is made 1¾ in. from the extreme right-hand edge of the wall board. The back, top, and sides of the fireplace opening are formed of wall board or cigar box wood, as preferred.

The dutch oven is an opening large enough to hold a box of safety matches. This is placed 1¾ in. from the left-hand edge of the wall board and 3¼ in. from the bottom, and is boxed in behind like the fireplace. A door is made for this opening out of sheet copper, which is hammered to a convex shape and coated with black paint to resemble iron. It swings on hinges made from small brads bent at right angles and driven into the wall board. Below the dutch oven there is a smaller false door glued to the wall board.

Above the fireplace opening a piece of cigar box ½ by 4½ in. is glued and colored to imitate an old charred timber. The mantelshelf is a piece of cigar box wood ⅞ in. wide and 10½ in. long, fastened with small brads to the top of the wall board. Below this is a reproduction of an old flintlock gun carved from wood, and on the mantelshelf is a tiny reproduction of a pewter plate, made of tin.

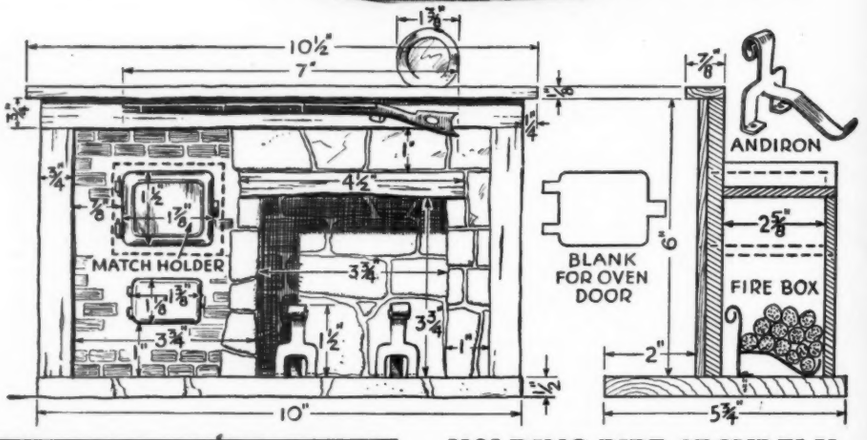
The fireplace is fastened to the pine base 2 in. from the front edge so as to leave a hearth. The andirons are cut out of sheet copper and fastened in the fireplace opening to hold the cigarettes.

The hearth is painted to represent different colored stones, and the front of the fireplace is treated to look like old brick and stone.—H. L. STAPLES.



This miniature fireplace, built from wood, wall board, and a bit of sheet metal, is a cigarette holder. Matches are kept in the dutch oven

The cigarettes are piled in the fireplace opening as if they were birch logs resting on the andirons. The dimensions of the original model are given below, but they do not have to be followed in every detail



WIRE BRUSH REMOVES CHIPS FROM CHUCK

FOR cleaning chips from the threads of a chuck back, the quickest and best method with which the writer is familiar is to use a wire brush as shown. The wooden back of the brush can be cut down or built up as required to fit the threaded hole properly. If this is done, it requires only a few sweeps back and forth to remove the most tightly stuck chips. It is best to hold the brush firmly and revolve the chuck on the bench. —J. H. DEERY.

MASHING UP WHITE LEAD

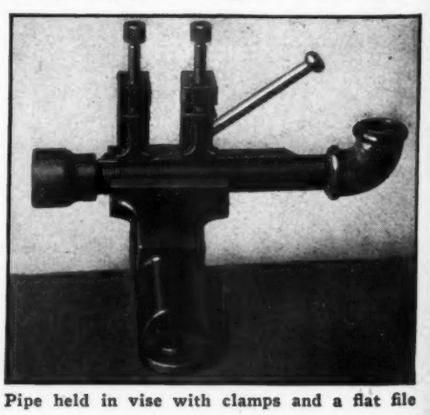
IF YOU mix your own paints with paste white lead, you can save yourself considerable labor in breaking up the white lead by using an ordinary ten-cent wire potato masher.—R. E. WISMER.

SHELLAC MENDS CRACKED FOUNTAIN PEN CAP

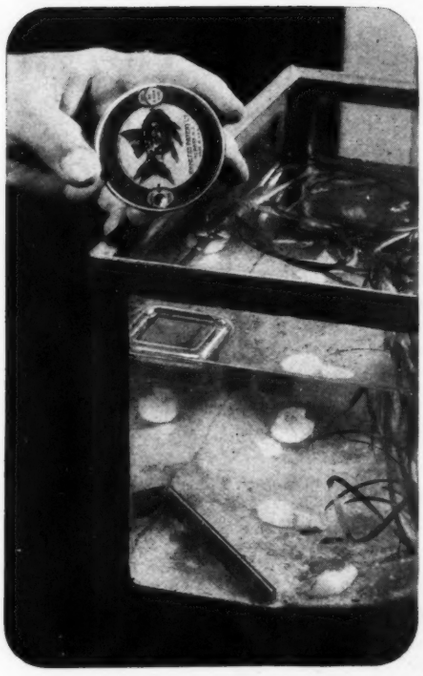
FOUNTAIN pen caps often become cracked in such a way that they will no longer stay on the pen body. If the crack is not too bad, it may be repaired by brushing shellac around the cap at the point of the break and then winding on some fine, strong thread. Keep the turns close together and make what is known as an "invisible" ending. Finally, apply shellac to the binding. When the shellac is dry, it will be found that a durable repair has been effected.—H. HENNY.

HOLDING PIPE SECURELY IN SMALL BENCH VISE

WHEN connecting up a new gas stove, I needed a pipe vise. My small bench vise would not hold the pipe, but I made it do, nevertheless, by supplementing it with a pair of small clamps and a broken flat file as shown in the illustration below. With this set-up, the pipe was gripped in four places, and it did not turn or creep out of the vise when I applied the leverage necessary to tighten the joints.—W. M.



Pipe held in vise with clamps and a flat file



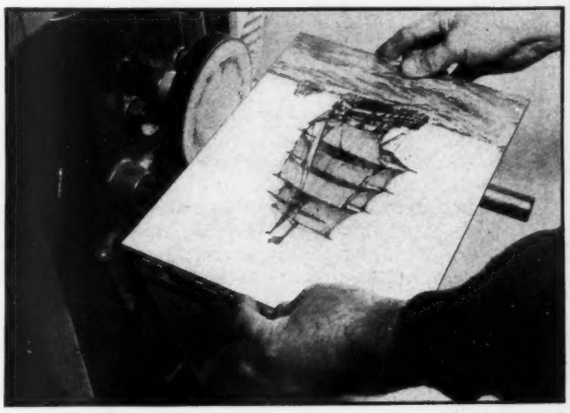
Fish food not eaten in the feeding ring drops into the triangular space at bottom

AQUARIUM HAS TRAP TO CATCH SURPLUS FOOD

DECAYING fish food is a constant source of pollution and trouble in many aquariums. Not being able to talk, the fish can't tell you how much they want, and if you give them too much, the left-over material starts to decay in a short time.

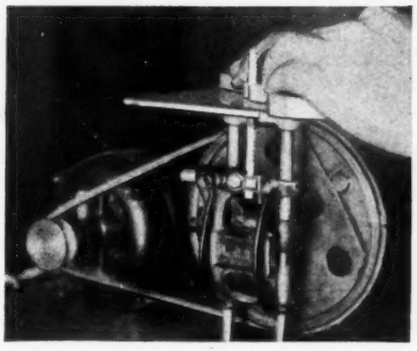
The use of a floating feeding ring, obtainable at any aquarium supply store, is a help because it keeps the food in one spot till the fish eat it or it sinks to the bottom. The photograph above shows an addition that still further simplifies the problem. The sand, under the corner where the feeding ring floats, is pushed back and held in that position by a thin strip of glass set diagonally across the corner. The water-logged food drops into this clear spot and, if not eaten, it can be siphoned off without removing, at the same time, a large portion of the sand from the bottom.—E. D. P.

SANDER TRIMS PICTURE PUZZLE EDGES



OFTEN it is difficult to find a method of trimming the edges of a jig-saw puzzle smoothly unless an extra table with a guide fence is added to the saw. A neat way to do this is to pass the edges of the puzzle against a fast cutting disk sander. A guide is not necessary; skill in moving the puzzle, and at the same time keeping it flat against the disk, is quickly acquired. Even relatively large picture puzzles can be trimmed accurately in this way.—G. S. G.

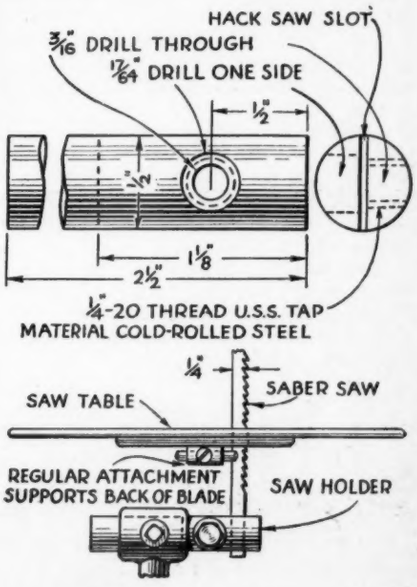
HEAVY STOCK CUT ON SMALL JIG SAW



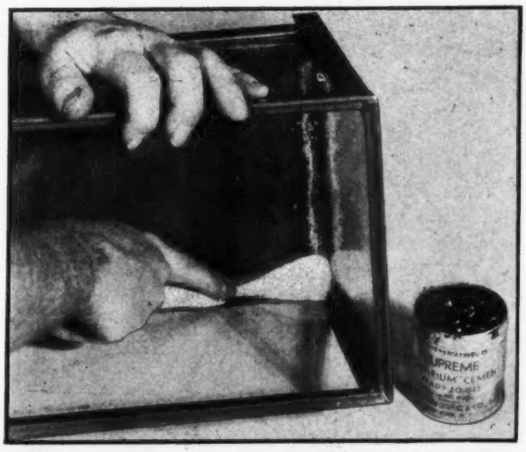
ONE of the small jig saws in common use may be converted into a saber saw by substituting the attachment shown for the saw frame. The vibration will then be decreased, and much heavier work can be handled. I have sawed 1¾ in. thick white pine with ease on the saw illustrated.

The new saw holder consists of a piece of cold-rolled steel ½ in. in diameter and 2½ in. long. Cut a hack saw slit 1⅛ in. deep across the center of one end. Then, ½ in. from this same end, drill a 3/16-in. hole through at right angles to the saw slit. Redrill one side 17/64 in. as far as the saw slit. Tap the other side with a ¼-in. 20-thread U. S. Standard tap by inserting the tap through the 17/64-in. hole as a guide. Insert a ¼-in. 20-thread cap screw ⅝ in. long, with a washer under its head.

A hold-down finger need not be used for most work. If saber saws cannot be obtained conveniently, use short sections of old ¼-in. band saws or pieces of turning saw blades.—E. C. WITTICK.



REPAIRING AQUARIUMS THAT LEAK



The cement is applied liberally inside the joint and then coated with dry sand to form a tough outer skin

ALTHOUGH the commonly recommended method of repairing leaks in aquariums is to push cement into the cracks from the outside, this procedure has its disadvantages. A sure cure for all leaks, no matter if the aquarium is leaking at every joint, is to force a strip of aquarium cement into the angles formed where the glass panes join on the inside of the aquarium. After you have formed the cement into a smooth radius, pour some dry sand into the aquarium and rub this gently into the streaks of cement as shown in the accompanying illustration. The sandy outer layer helps hold the cement in place.—L. R.

TINY SAFE IN BED LEG

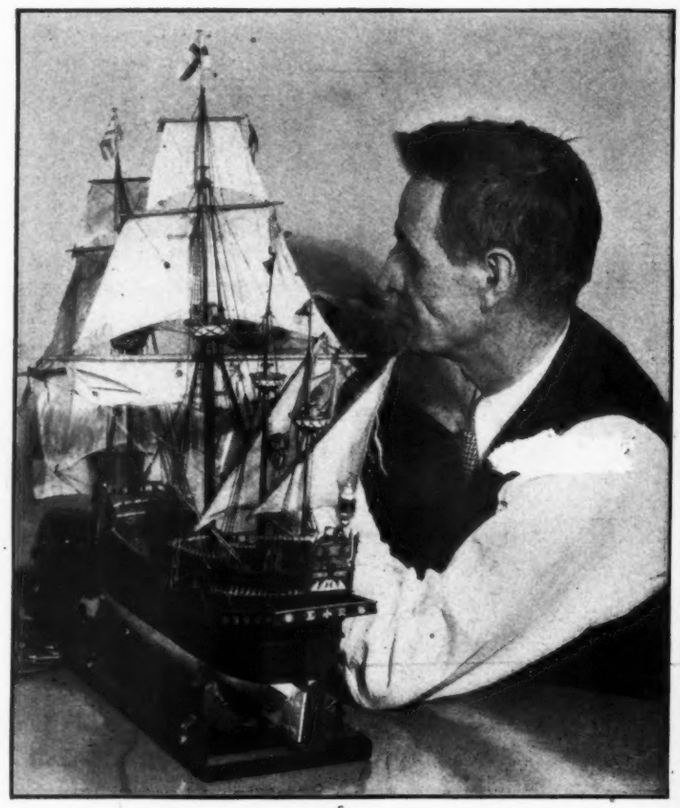
BECAUSE of a secret hiding place I have in a hollow leg of my metal bed, I have on two occasions saved cash and jewelry from loss. To make such a compartment, remove the caster from one of the legs at the foot of the bed and obtain a short tube that will fit snugly inside the post. Solder this tube to the springs which hold the caster in place. It is somewhat inconvenient to have to lift the corner of the bed to remove the caster and tube, but the hiding place is not likely to be discovered by a burglar and it is also comparatively fireproof.—A. V.

We Make Masts *and* Yards

By Captain E. Armitage McCann

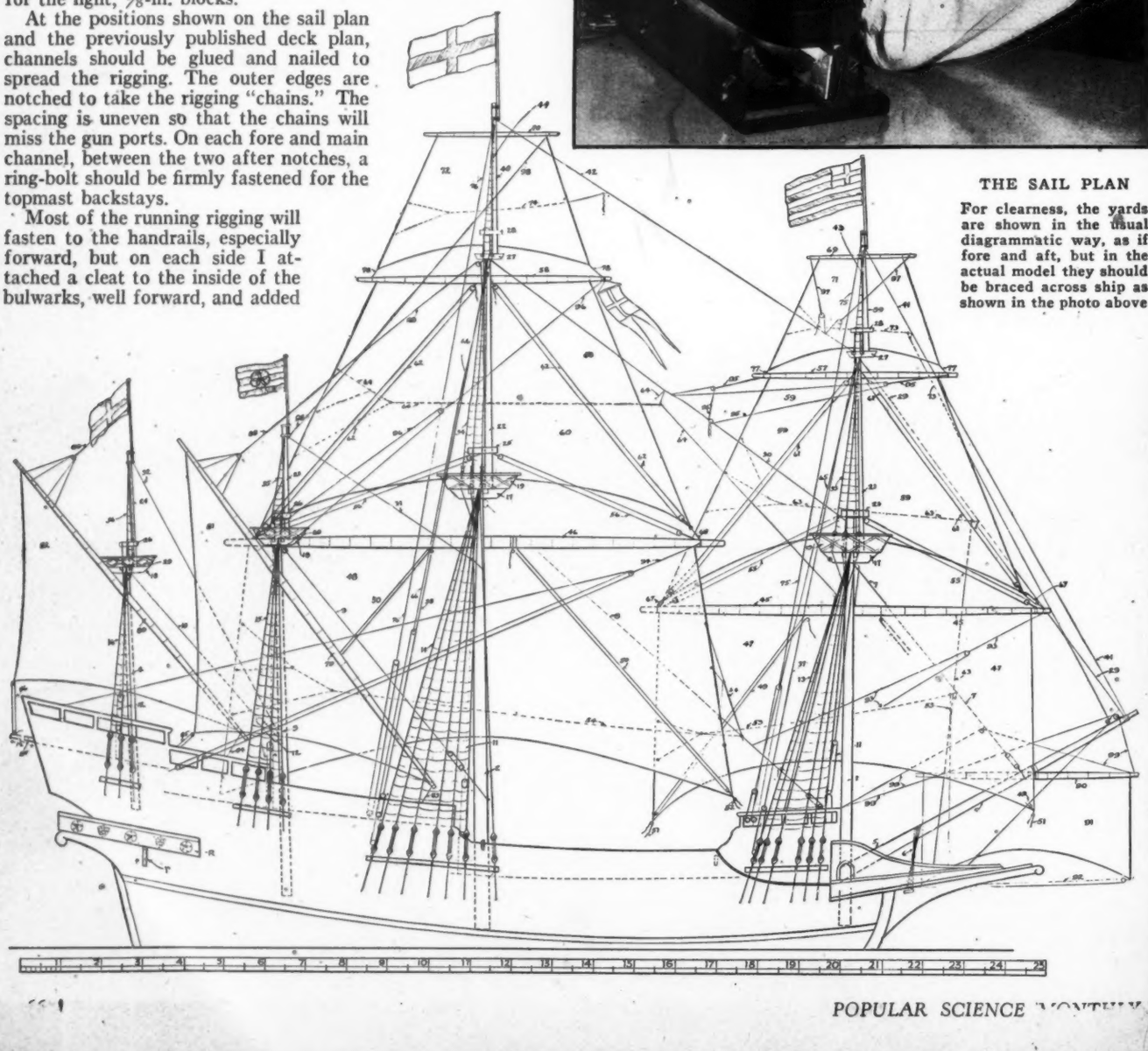
NOW we are ready to make the masts and yards and start rigging our model of the picturesque Elizabethan galleon *Revenge*. In the two preceding articles of this series (P.S.M., Apr. '33, p. 65, and May, p. 67), we said something about what a famous fighting ship this was, but as an inducement to new readers to build a model of her, it is worth while repeating that her name is one of the greatest in all naval history. Her most heroic fight was her last, in 1591, when she battled fifty-three Spanish galleons. Her commander was Sir Richard Greynville, an ancestor of Sir Wilfred T. Grenfell, M.D., who has so long been fighting disease among the Eskimos of Labrador.

Those who missed the previous installments should look them up. Full size blueprints also can be obtained to make the work easier. In connection with the sail plan, it should be noted that the parts are identified by numbers, and the complete key is given on page 81. This table also shows the sizes of the rigging cord. These are indicated by the letters *a*, *b*, and *c*. Size *a* (heavy) should be about equal to No. 18 (B. & S.) gage wire; size *b* (medium) to No. 22 wire, and size *c* (fine) to No. 30. Hard-laid linen cord is best, such as fishline. The standing or fixed rigging should be black or very dark brown, and the running rigging a natural color or light brown. For the medium size rigging, use ¼- and 3/16-in. blocks, and for the light, ⅛-in. blocks.



At the positions shown on the sail plan and the previously published deck plan, channels should be glued and nailed to spread the rigging. The outer edges are notched to take the rigging "chains." The spacing is uneven so that the chains will miss the gun ports. On each fore and main channel, between the two after notches, a ring-bolt should be firmly fastened for the topmast backstays.

Most of the running rigging will fasten to the handrails, especially forward, but on each side I attached a cleat to the inside of the bulwarks, well forward, and added

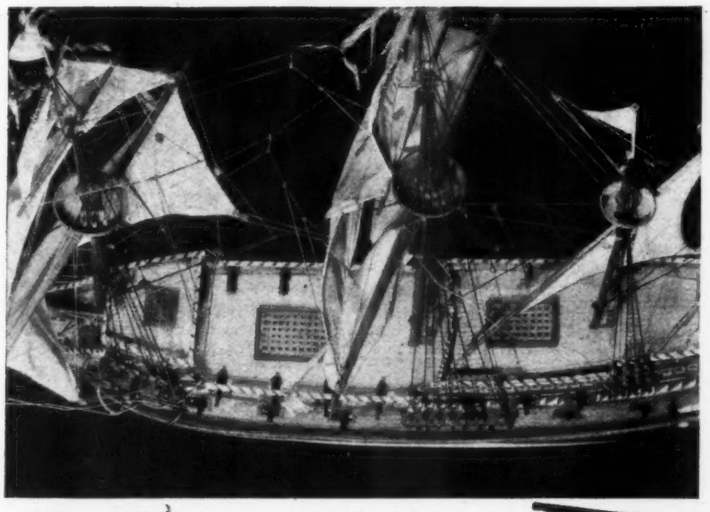


THE SAIL PLAN

For clearness, the yards are shown in the usual diagrammatic way, as if fore and aft, but in the actual model they should be braced across ship as shown in the photo above

for the "REVENGE" Model

And get the channels, crosstrees, trestletrees, tops, and caps ready to set up her picturesque rigging



This unusual view of the completed model shows the circular mast tops and the shrouds clearly, and also the angles at which the yards are placed

Bowsprit, masts, and crosstrees in place. The tops are shown lying on the temporary base

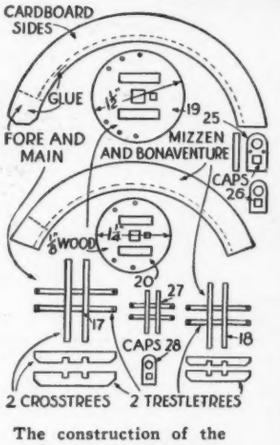
two short rails for belaying pins each side aft, with four pins on the forward one and two on the after. Drive in some eyebolts (sturdy bent-over pins) for the topsail and topgallant halyards.

The masts are shown on the rigging plan as *1, 2, 3,* and *4*. The foremast is 5/16 in. in diameter, the mainmast ⅜, the mizzenmast ¼, and the bonaventure 3/16 in. They each taper slightly to the top. The bowsprit is 5/16 in. and tapers to half where stays *29* and *41* come. Beyond that there is a slight shoulder.

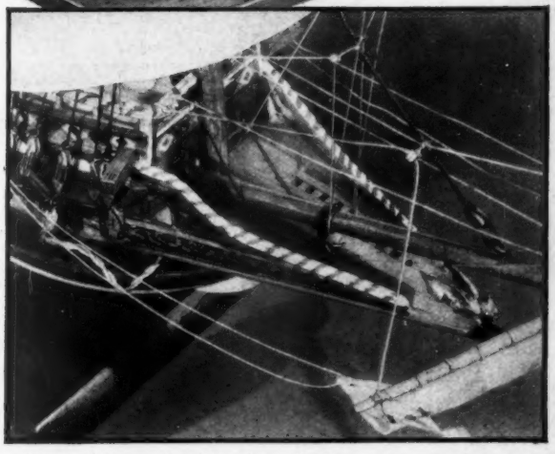
From the point where the trestletrees *17* and *18* (fore-and-aft parts of the crosstrees) are to be placed, the masts are squared to the top; and on the extreme ends a slightly smaller square is cut for the caps *25* and *26*.

The lengths and diameters of all the other spars can be obtained from the full size blueprints or by scaling the drawings on page 66. The topmasts are squared at the doublings, like the lowermasts, and are cut square at the heels to fit in the holes in the tops. This is easier than fidding them (holding them with a pin).

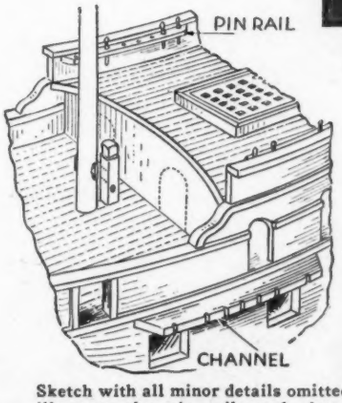
All the yards taper from the middle to about one half the diameter at the ends and have a slight shoulder at the yardarms.



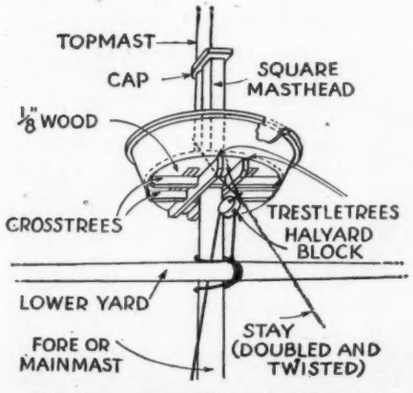
The construction of the various tops, crosstrees, trestletrees, and caps



Beak of the model. Note how the bowsprit passes at one side of the foremast and is lashed with the gammoning



Sketch with all minor details omitted to illustrate the pin rails and channels



How the mast tops and caps are set up and the lower yard halyards are provided for

I made all of the spars from birch dowel sticks and stained them light brown. Make the lowermasts long enough, of course, to go to the bottom of their holes, which, it will be noticed, are of different depths. Do not place them yet.

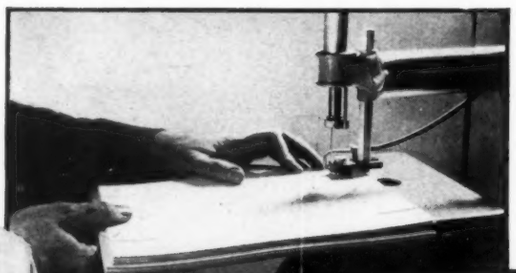
Having made the spars, ship the bowsprit and pass the gammoning *6*. This is a piece of the heaviest cord passed from a notch on the bowsprit through the grating and through the slot in the beak. Get it so tight that the bowsprit is slightly bent.

Make the crosstrees shown at *17* and *18* ("crosstrees" meaning the whole assembly). These are pieces of hardwood halflapped into each other to fit tightly on the square of the masts, where they are glued and, for preference, also nailed with a ½-in. pin. Those marked *17*, for the fore and main, are the same; and those marked *18*, for the mizzen and bonaventure, alike, only smaller.

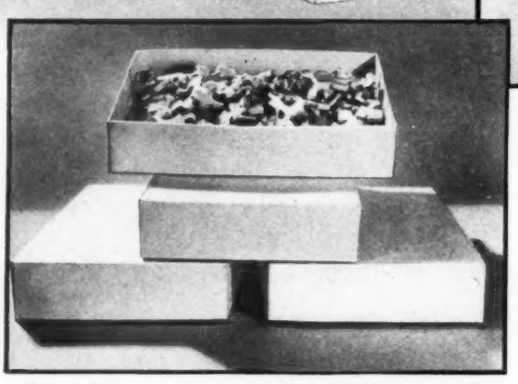
On the crosstrees rest the tops. These are circular pieces of wood cut at a bevel, and around them are glued pieces of Bristol board of the shape shown, so that they will flare out. Around the top edges are glued thin pieces of chair caning spline or cardboard. They *(Continued on page 81)*

It's Easy to Make Cardboard Boxes for Puzzles and Novelties

The boxes and covers are cemented with water glass and held with spring clothespins



Six cardboard pieces—three for bottoms and three for covers—are squared up, and a cut is made at each corner 1½ in. from the corner and 1½ in. long, as at the left. The bending lines are later scored with a blunt nut pick as illustrated below



Three of these neat boxes, which hold 300-piece wooden jig-saw puzzles, are made at a cost of about five cents

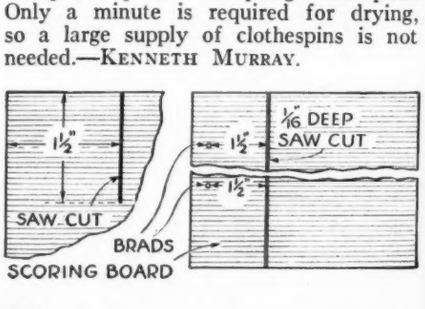
UNIFORM, attractive boxes are necessary in the marketing or presentation of jig-saw puzzles and other small wooden novelties made in the home workshop. Box prices are usually about a dollar a dozen, but by the following method it is possible to make first-class sturdy boxes at a net cost of about three for five cents.

The boxes illustrated hold a 300-piece puzzle nicely, and three are made with but little waste from a 22 by 28 in. sheet of six-ply white enameled or colored cardboard. From each sheet cut three pieces 8½ by 11 in. for the tops, and three pieces 8 5/16 by 10 13/16 in. for the bottoms. These are held together with one corner squared up, and a 1½ in. long cut is made on the scroll saw 1½ in. from the edge, as shown. The other corners are squared up, one at a time, and cut in the same manner.

A scoring board is next made. This is a piece of veneer or other smooth material about 11 by 15 in. with a 1/16 in. deep saw cut made in the surface at a distance slightly more than 1½ in. from one of the longer edges, as illustrated in one of the small diagrams at the right. Two small brads are placed exactly 1½ in. from the saw cut to serve as guides. The scoring tool is a metal nut pick, ground down to a blunt, smooth end.

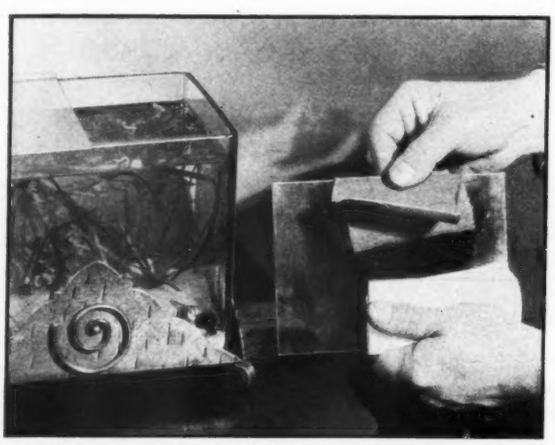
To score the cardboard, lay it on the board and press one edge against the brad guides as illustrated in one of the photographs. Then use considerable pressure to force the cardboard down into the saw cut with the tool. To prevent cracking the cardboard, moisten it with a damp bit of cotton on the opposite side before scoring. A single quick wipe along the score lines is sufficient. To lubricate the tool it may be rubbed on a cake of paraffin.

The edges of the cardboard are now bent up, and the corner flaps given a thin coat of water glass (solution of sodium silicate) and clamped in place with spring clothespins. Only a minute is required for drying, so a large supply of clothespins is not needed.—KENNETH MURRAY.



SMOOTHING GLASS AQUARIUM COVERS

THE glass covers used on aquariums stocked with tropical fish are a potential source of danger every time you handle them. A slight slip, and the sharp edges are likely to cut ugly gashes in your fingers. To smooth the edges, hold the glass vertically by one edge, using your handkerchief or an asbestos pot lifter to protect your hand, and rub the upper edge with a piece of triple-0 emery cloth as shown at the right. Pay particular attention to the sharp corners. Treat each of the four edges in the same way, and you will have a piece of glass you can handle without fear.



Using a piece of emery cloth to smooth the sharp edges and corners of the cover glasses for a tropical aquarium

LONGER LIFE FOR JIG-SAW BLADES

WHEN the finer sizes of jig- and scroll-saw blades break frequently, the cause is often unnecessary wear rather than poor quality steel. Slotted guide wheels, in particular, are likely to wear away both the sides and back of the blade. Examination of broken blades will often show that they have been worn extremely thin. This can be avoided and the blades made to last much longer by using the V-notch of the guide wheel and setting the blade so that it makes contact with the guide only when work is being fed against it. Let it run entirely free at other times.

Camper's Folding Frying Pan

By Leonard F. Merrill

Expert woodsman and Maine guide

FRYING pans are a necessity of the trail that few outdoorsmen care to do without. The ideal pan, of course, is one with a folding handle that can be stowed away conveniently in a pack or knapsack. In these days, few of us care to buy an expensive folding pan such as those offered by sporting goods dealers, but the pan to be described is just as efficient in every way and costs only 18 cents.

Materials. A sheet iron frying pan from the 5-and-10-cent store (they come in three sizes); one 1½-in. butt hinge, six short flathead stove bolts, six nuts for the bolts, and one corner iron ½ by 1½ in.

Tools. Tinners snips, a file, a drill that will make a hole large enough for the stove bolts, a screw driver, hammer, and pliers.

Method. Cut the handle from the pan as nearly even with the rim as possible. Flatten the lower end of the handle, and square and trim the end and sides of the flattened part. Trim the rim of the pan where the handle was removed.

With the handle in place at the rim of the pan, hold the hinge on the inside of the pan and on the upper side of the handle. Mark the centers for the holes. Drill the holes and fasten the hinge in place with four stove bolts.

Cut one end of the corner iron off between the two holes. Bend this short side or end out to form an angle of about 120 deg. With the long end of the iron on the underside of the handle, slide the iron down until the short end comes in contact with the side of the pan. If the handle is not at the angle desired, bend the short end until the slant is satisfactory. Hold the brace in place and mark the centers of the two holes in the long end of the iron. Drill corresponding holes in the handle and fasten the iron to the handle with the two stove bolts which were not used before.

The frying pan in use and with the handle folded inside, ready to be packed; and views showing how the end of the handle is filed and how the hinge and brace are bolted on

When everything is satisfactory and the nuts are as tight as possible, file the ends of the bolts off until only about 1/16 in. remains beyond the nuts; then head over the ends of the bolts with a hammer as you would a rivet.

CARRYING EXTRA GAS IN SMALL BOATS

FOR carrying an extra supply of gasoline on a 14-ft. outboard runabout, I use four individual holders like the one illustrated above. They are screwed to the floor in a row running across the boat just back of the front seat and are kept covered with good-looking rubberized cloth. Each holder is merely a strip of galvanized sheet iron with a turned-over edge, bent and fastened to a round piece of wood, which forms the bottom. I soldered the seam up the side. The gasoline cans are of regulation design, and each holds two gallons, or eight gallons in all.—F. F. WILSON.

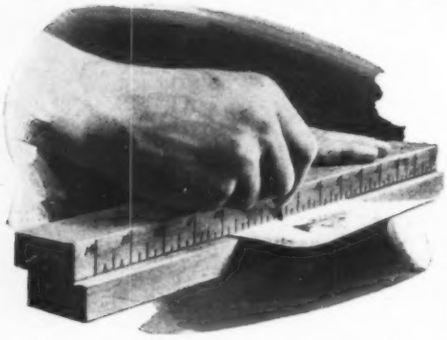
CEMENT EDGINGS HELP IN TRIMMING LAWN

A LITTLE cement properly used next to curbs, walls, clothesline posts, or any objects located in the lawn will save much hand trimming with the shears. Dig a trench 3 in. deep and 5 in. wide along the curb or around the object and fill it with a mixture of one part cement, two parts sand, and three parts gravel. Then the mower can cover the edges of the grass, as shown in the photograph above, and keep it looking neat without the need of trimming by hand.—LEWIS SHIRLEY.

With one wheel of the mower on the cement, the grass can be trimmed to the very edge

Embossing Your Own Prints

and other hints for AMATEUR PHOTOGRAPHERS



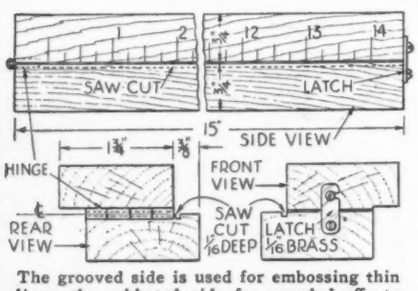
The print is clamped in the embosser and a pointed stick serves as the embossing tool

AMATEUR photographers can emboss their prints neatly with the simply made device illustrated above. The materials required are two pieces of white pine or some other softwood ¾ by 1¾ by 15 in. and a small 1-in. hinge. The two strips are laid together and offset ⅜ in.; then a line is drawn with a pencil on each projecting side. In one piece a groove 1/16 in. deep is cut along the line with a saw. Another groove is cut along the line in the other piece to the same depth, but in this piece the wood between the groove and the edge of the strip is removed with a chisel, forming a rabbet, as shown in the drawing below.

The pieces are then laid together in the proper relationship, and the mortise for the hinge is marked and cut at one end. At the other end a hook or latch of wire or thin brass is attached.

To emboss a print with a line, the grooved side is used. Clamp the margin of the print in the embosser as shown in the photograph; then draw a pointed stick over the groove. This pushes the paper into the groove and gives a neatly embossed line. By using the side with the rabbet in the same way, the print can be given a paneled effect, with the middle of the print set below the margins.

For measuring, the edge of the embosser is marked as shown.—FRANK WILDING.



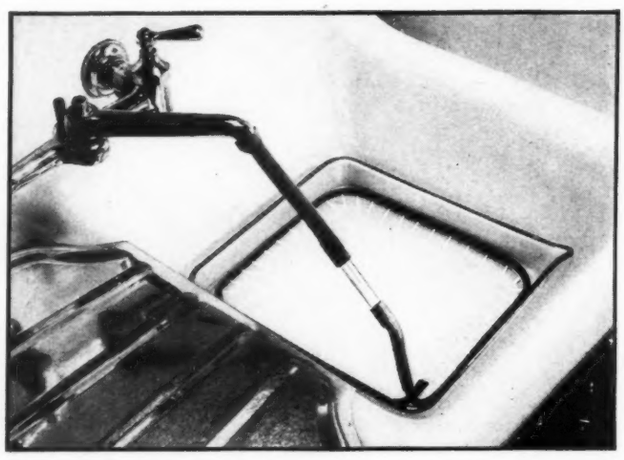
The grooved side is used for embossing thin lines, the rabbeted side for paneled effects

Print and Film Washer

THE cheap and efficient washer for photographic prints and negatives illustrated in the center of the page can easily be made from a length of ⅜-in. copper tubing obtainable at most hardware and plumbing supply stores. The tubing is bent to fit closely around the bottom of the washing tray, with a 3- or 4-in. section to be used as an intake. Care should be taken that the tubing is not closed by the bending. A series of holes about 1/16 in. in diameter, spaced approximately ¾ in. apart, should be drilled or punched in the inner side of the rectangle made by the tubing.

The blind end of the tubing should be hammered flat so that only a very thin stream of water flows out. This permits a current of water to circulate around the tray, yet causes enough back pressure to insure small but powerful jets from each of the holes in the sides of the tubing. These small streams keep the prints from lying on the bottom of the tray and at the same time prevent the hypo from settling there, causing it to flow over the top edges of the tray.

A short piece of glass tubing is used between the two hose. This acts as an adapter and also allows the pressure of the water to be regulated by watching the water level in the glass tube. This washer, despite its simplicity, has proved efficient.—JACK H. LEICHT.



Jets of water shoot out from the copper tubing, and a thin stream flows from the end to keep the water circulating steadily around the tray

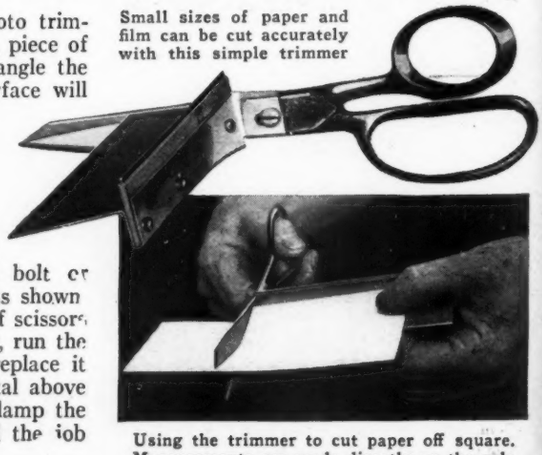
An Album Slotting Tool

CORNER slots for mounting prints in a photo album can be made quickly with a tool like that shown above. It consists of two safety razor blades fastened one on each side of a stick of wood about ⅛ in. thick. By drawing the twin blades across the corner of an album leaf for about 1 in., a neat ribbon is cut, and four of these make it possible to mount a photo without using paste or sticking on special photo mounting corners.—H. E. HAYDEN.

Small Photo Trimmer Made from Scissors

START making this small photo trimmer by bending a 2 by 5 in. piece of 28-gage sheet metal at a right angle the long way so that the larger surface will measure 1½ by 5 in. Turn down at a right angle 1 in. at the end of another ½ by 6 in. strip and drill a ⅛-in. hole in the center of the ½ by 1 in. surface. Cut a ruler off at the 5-in. mark, place it between the two pieces of metal, and bolt or rivet the three pieces together as shown. Remove the screw from a pair of scissors with blades at least 3½ in. long, run the screw through the ⅛-in. hole, replace it in the shears, and bend the metal above and below the screw so as to clamp the scissors. Tighten the screw, and the job is complete.—LOUIS HARING.

Small sizes of paper and film can be cut accurately with this simple trimmer



Using the trimmer to cut paper off square. Measurements are made directly on the rule

EASTMAN NEWS BULLETIN FOR THE AMATEUR PHOTOGRAPHER

JUNE, 1933, PUBLISHED BY EASTMAN KODAK COMPANY

INDOOR SNAPSHOT SPEED

Kodak Super Sensitive "Pan" is 50 per cent faster than even Verichrome Film in morning and afternoon light.

It is THREE TIMES as fast under electric lights. Makes pictures indoors at snapshot speed with low-cost Photoflood lamps.

Picture above: 1/25 second, *f*.4.5, two Photoflood lamps in reflectors.

NOW—Kodak Super Sensitive Panchromatic Film *in* ROLLS *and* PACKS

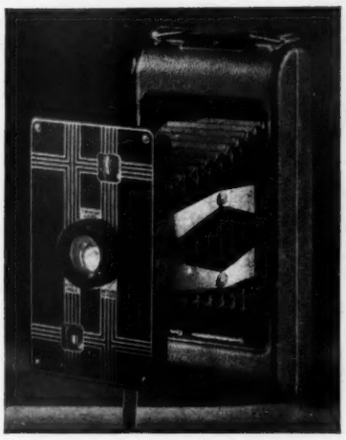
Photo fans everywhere—Here it is!—An ultra-fast, fully panchromatic film for roll film and film-pack cameras.

So fast that it makes INDOOR SNAPSHOTS easy. Sensitive to all colors. Gives true visual brightness to all subjects... permits special tone effects with filters.

Opens new picture possibilities to all cameras. Gives utmost scope to the new fast Kodaks.

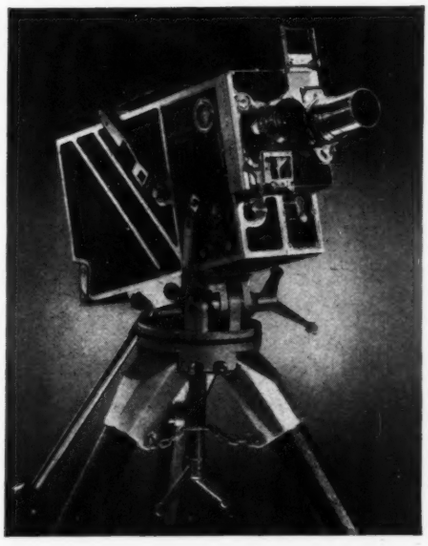
Order a supply of this marvelous new film today. At your Kodak dealer's.

Green lightning on the yellow box identifies the new Kodak Super Sensitive Panchromatic Film.



POP—IT OPENS

The new Jiffy Kodak—simplest folding camera ever devised. Touch one button. It pops open, all set for action. Touch another. Click. It snaps the picture in clear, sparkling detail. Smart in action. Smart in appearance. Compact, convenient to carry. Jiffy Kodak Six-16 takes 2½ x 4¼ pictures. See it at your dealer's. Price, $7.50.



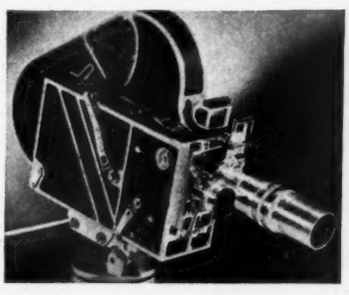
NEW CINÉ-KODAK OF AMAZING SCOPE

Fade-ins, fade-outs, dissolves, animations, variable slow motion, and multiple exposures are but a few of the unusual movie effects easily achieved by the new Ciné-Kodak Special—the most advanced of all 16 mm. movie cameras.

The Ciné-Kodak Special has spring, electric, and hand drives for normal, slow motion, or single frame exposures. Reverse wind permits double or multiple exposure, dissolves, etc. Double lens turret with exposure scales and finders, focal plane focusing, adjustable shutter for fast action shots. Speeds from 8 to 64 frames a second. Interchangeable 100- and 200-foot film chambers. Send coupon for the Ciné-Kodak Special booklet, describing other features of this versatile camera.

Left: Ciné-Kodak Special with 100-foot film chamber, on tripod. Note double lens turret, controls on side panel, and adjustable tripod head.

Right: The Special with 200-foot film chamber attached. Instantly interchangeable with the 100-foot chamber. Permits over 8 minutes of picture taking without reloading. Chambers can be changed without loss of film frames.



LIGHTS UP!

This low-cost Kodaflector gives you abundant light for indoor pictures. With the new Super Sensitive film it makes snapshots and movies at night easy and certain. Permits making Kodacolor movies indoors. Uses two Photoflood lamps, mounted with reflectors on a light, swivel-head stand. Reflectors lie flat when not in use. Stand telescopes in small space. Price, $5.

If it isn't an Eastman, it isn't a Kodak

FOR THE HOME DARKROOM

Here's a real hobby, finishing your own snapshots. Kodak Darkroom Outfit No. 1 (above) contains everything you need for developing films and making prints. Complete with durable black fiber case and instruction book, $8.75. Send coupon for catalog describing this outfit and other photographic equipment.

MAIL COUPON FOR NEW FREE CATALOGS

P. S. 6-33

Eastman Kodak Company, Rochester, N. Y.

Please send me the new catalogs checked below.

← ☐ 1933 Catalog of Cameras and Supplies

☐ Ciné-Kodak Special Booklet

Name.....

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A GRACEFUL Monoplane MODEL

Simplified for Beginners

By DONALD W. CLARK

NINETEEN easily made units are all the parts required to build this graceful wooden model of a Fairchild cabin monoplane. Nails, rivets, and washers, of course, are not counted. The scale of the model in relation to the full size plane is ⅜ in. equals 1 ft.

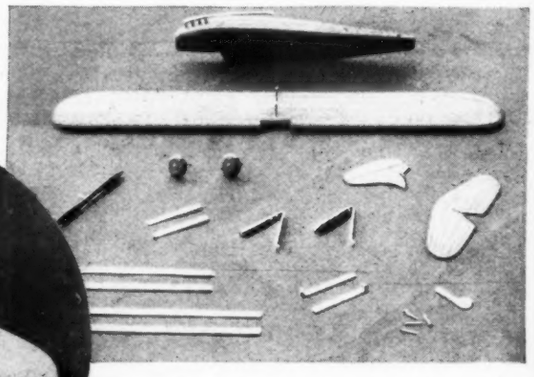
Saw out and plane a white pine block to 1 by 1⅝ by 8½ in. Mark the fuselage profile and top lines, saw the horizontal and vertical tail slots, and carve the block to shape. Drill four 3/32-in. holes in the bottom of the front end to take exhaust pipe *E*, and a hole at the tail for the rear wheel, which is held in with match stick wedges.

Cut the wing from a piece 3/16 by 2⅛ by 15 in. Saw out a notch in the middle of leading edge as shown. Mark the aileron lines and press them in with the back of the knife point. Cut the tail units from thin aluminum, fiber, or stiff cardboard.

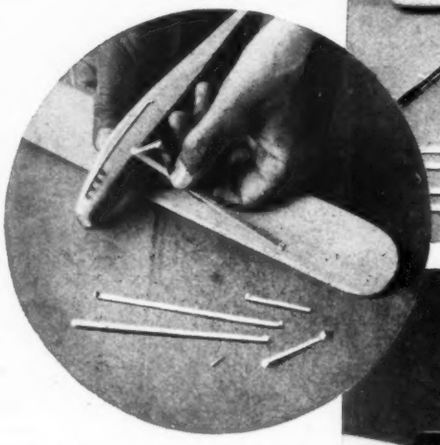
Make all the struts of thin aluminum. Measurements are given from bend to bend except in a few cases where the bend-to-hole centers are dimensioned. The two front wing struts have holes 1⅛ in. from the bottom bend to take rivets for fastening struts *B* and *D*.

The wheels are made of 3/16-in. wood ¾ in. in diameter. They can be made without a lathe. Simply draw the circle, cut to shape with a knife, and finish with sandpaper. Roundhead nails serve as axles, the ends of which can be either flattened or touched with solder.

The model will look well if painted as follows: Fuselage, propeller, vertical tail, all struts, and tail-wheel fork, bright red; wing, horizontal tail, wheels, radiator, and windows, buff; tires, black. The exhaust pipe should be polished.

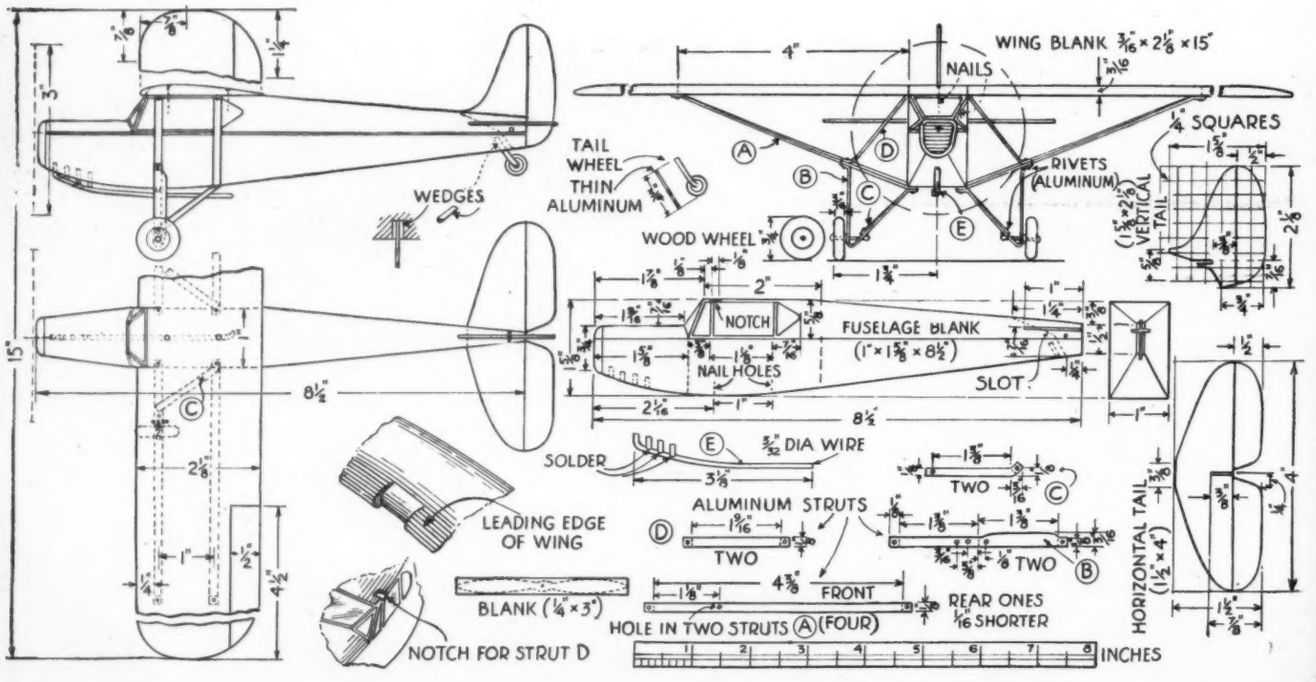


These are the parts of the Fairchild monoplane model. The wing and fuselage are wood, but the tail units may be thin aluminum, fiber, or even strong cardboard



The struts, which are made of thin aluminum, are fastened to the fuselage and wing with small nails and to each other with tiny rivets of aluminum wire, if available. Note especially the exhaust pipe of wire

Inserting the tail units in their slots. The location and shape of the slots can be seen distinctly in the detail drawing of the fuselage given in the group below



ILLUSION:
In India, the fakirs present a spectacle to tourists. Two lovely performers appear, throw jagged pieces of glass into a box already filled with broken glass. They step *barefooted* into the box and do an Oriental dance—uninjured.

EXPLANATION:
Before appearing the performers toughen their feet in a solution of alum water and rub them with pulverized resin. They throw the sharp glass around the *edges* of the platform. The glass on which they actually do dance has the edges rounded off. They just *pretend* to dance on the *sharp* glass.

SOURCE: *"Magic Stage Illusions and Scientific Diversions" by Albert A. Hopkins, Munn & Co., New York.*

Copyright, 1933, R. J. Reynolds Tobacco Company

IT'S FUN TO BE FOOLED ...IT'S MORE FUN TO KNOW

One of the tricks of cigarette advertising is to pretend that "Heat Treatment" is an exclusive process, making one cigarette better than any other.

EXPLANATION: *All* cigarette manufacturers use heat treatment. The first Camel cigarette ever made, and every one of the billions of Camels produced since, has received the necessary heat treatment. Harsh, raw tobaccos require *intensive* processing under high temperatures. The more expensive tobaccos, which are naturally mild, *call* for only a moderate application of heat.

It is a fact, well known by leaf tobacco experts, that Camels are made from finer, MORE EXPENSIVE tobaccos than any other popular brand.

Try Camels. Judge them critically. Compare them with others for mildness, for throat-ease, for good taste. They'll win you!

KEPT FRESH IN THE WELDED HUMIDOR PACK

NO TRICKS
—JUST COSTLIER TOBACCOS
IN A MATCHLESS BLEND

WHEW! WHAT A NARROW ESCAPE! AND THE TIRE WAS ALMOST BRAND-NEW!
EVERY YEAR THOUSANDS ARE KILLED OR INJURED WHEN BLOW-OUTS THROW CARS OUT OF CONTROL

NOW YOU'LL BE 3 TIMES SAFER

FROM BLOW-OUTS AT HIGH SPEEDS

See how this utterly new way of making tires prevents blow-outs by overcoming the CAUSE of blow-outs before they start

WHEN your speedometer reads 40, 50, 60 and 70 . . . mile after mile . . . the heat *inside* the tire becomes terrific. Rubber and fabric begin to separate. A blister starts . . . and grows . . . bigger and bigger, until BANG! A blow-out! And a terrible drag pulls your car off the road.

How it prevents blow-outs

To protect you from blow-outs, every new Goodrich Safety Silvertown Tire has the amazing Life-Saver Golden Ply. This new invention resists heat. Thus, rubber and fabric don't separate. Blisters don't form. The *cause* of blow-outs is eliminated *before* they start.

Three times safer

At gruelling speeds on the world's fastest track, the new Goodrich Safety Silvertown, with the Life-Saver Golden Ply, lasted *3 times as long* as first quality tires that did not have this feature. These SILVERTOWNS *never* blew. They were run till the tread was gone . . . but the Life-Saver Golden Ply refused to give!

Don't think that slower driving can save you from blow-outs. Long trips at 35 or 40 miles an hour can generate terrific heat, too. To be safe—have the protection of the Life-Saver Golden Ply. It's Free! Just make sure you buy a SILVERTOWN Tire, which costs not a penny more than other standard tires.

Isn't this the kind of tire you want for *your* car? Then decide now to equip your car with Goodrich Safety Silvertowns—the only tires in the world built with the Life-Saver Golden Ply.

Look up your nearest Goodrich dealer's name under "Tires" in your classified telephone directory. Put *real* protection between yourself and the road . . . for your family's sake and your own!

FREE! This handsome Safety League emblem with red crystal reflector to protect you if your tail light goes out. No obligation. Just join the Silvertown Safety League. Endorsed by Traffic Officials. Write today. Dept. 156, The B. F. Goodrich Rubber Co., Akron, Ohio.

The **NEW**

Goodrich *Safety* Silvertown

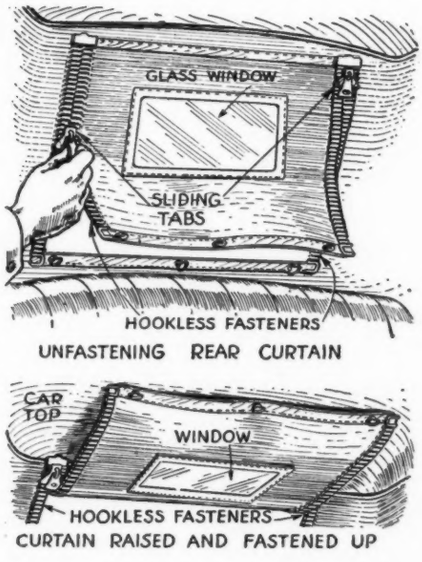
WITH LIFE-SAVER GOLDEN PLY

Copyright, 1933, The B. F. Goodrich Rubber Co.

The Month's Best
AUTO IDEAS

Hints, Useful to Car Workers, Are Supplied by Our Readers

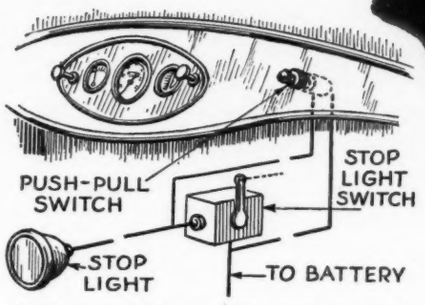
REAR window flaps on coupes and convertible roadsters can be made draft proof and rainproof by applying strips of hookless fasteners to the side joints. Ordinarily, the rear flap is provided only with three hooks along its bottom edge. As shown in the illustration below, the hookless fasteners, which can be purchased new or salvaged from old pieces of clothing, hand luggage, and so on, are stitched to the sides of the flap and the edges of the car top. Merely pulling the sliding tabs up or down opens or closes the flap. Obviously, the fasteners should be sewed in place so the open end is at the bottom. The hookless fastener strips can be stitched with carpet linen threaded in a sailmaker's needle.—C. F.



Hookless fasteners, stitched to the side of window flaps, will make your roadster rainproof

New Backing Light

BY CONNECTING a push-pull switch across the stop-light switch terminals, you can use your stop light also as a backing light. In the closed position, the push-pull switch completes the stop-light circuit independent of the brake and allows the light to be used when backing. When the switch is open, however, it does not interfere with the regular operation of the stop light by the brake pedal. To increase the illumination of the light, use a twenty-one-candlepower bulb in place of the usual type found in stop lights. The writer installed the supplementary switch on the dashboard, where it is handy for immediate use when a light is needed in backing at night on a dark road.—H. M. J.



A push-pull switch connected, as shown, across stop light terminals will give a backing light

Getting Your Car Out of Mud

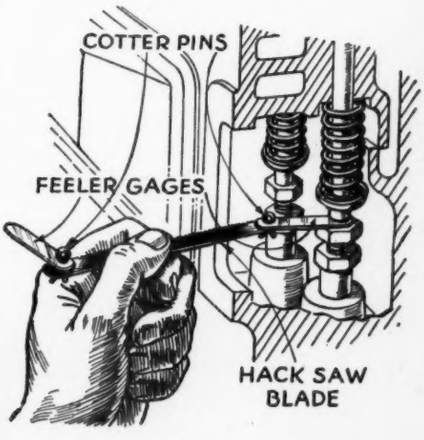
WHEN a rear wheel rests in the mud, a plank and some stout rope or a chain used in the manner illustrated will provide the necessary traction. Place the plank as far under the mired wheel as you can get it, tie the rope or chain to the outer end, and fasten the other end of the rope to the lowermost spoke of the wheel. Then start the motor, shift into low gear, and engage the clutch slowly. The wheel in turning will pull itself along the plank for one quarter of a revolution. By taking up the slack in the rope after each try, the car can be made to pull itself out of a mud hole in a very short time.—O. G.

A plank and a piece of rope can be used, as shown, to free a car when wheels are in mud

On piece of wall board, nailed up in garage, pages of auto kinks are pasted for reference

Auto Kink File

RATHER than lose the valuable kinks published each month in POPULAR SCIENCE MONTHLY, I now clip out the page and glue it to a board fastened to the wall of my garage. The board is merely a piece of wall board nailed to the studs. When I am working on my car and get stuck I glance over my work sheets and find the answer to my problem. I have also added a directory of of service stations.—D. G. R.



Using Feeler Gages

WHEN adjusting the valves on a car, the shortness of the feeler gages often causes undue fuss and aggravation. The work must be done in cramped quarters and the short gage strips are difficult to handle. To overcome this, the writer removed the exhaust and intake valve feeler leaves from the gage case and fastened them to the ends of an old hack saw blade as shown. Both gages are always ready for use and the saw blade serves as a handle.—B. W.

"Roughing it"

but at home you want a mattress

THERE'S a world of difference between sleeping on the hard cold ground, and nestling in a downy mattress.

For comfort you need springs, something to absorb jars and shocks. Like the springs in a mattress. Squibb Shaving Cream puts cushioned ease in shaving. The creamy lather makes the blade glide without rasps or tugs. And, after shaving, there's a velvet ease you've never felt before. For Squibb's contains oils essential to the comfort of the skin. It leaves your face smooth, pliant, and refreshed.

Send 10c for a guest-size tube to E. R. Squibb & Sons, 2306 Squibb Building, New York City.

• The right partner for Squibb Shaving Cream . . . Squibb Talcum, scented or unscented.

LATEST WAY TO INSTALL

Old Auto Engine *in a* MOTORBOAT

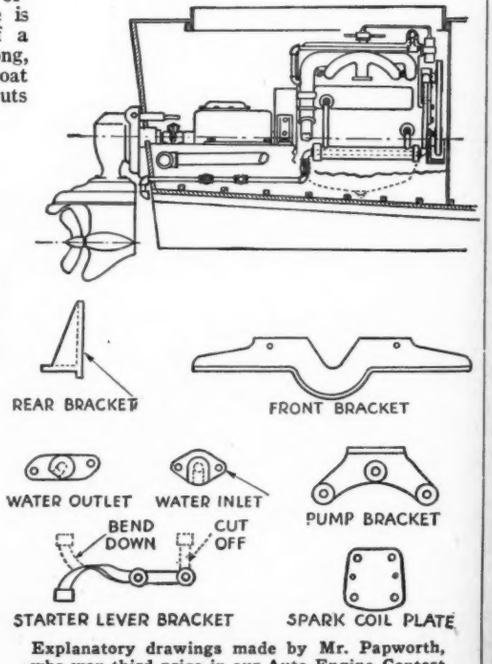
By Walter A. Papworth

I HAVE just finished installing a model "A" Ford engine in a boat in a way that offers several advantages. The engine is mounted level under the rear deck of a 21-ft. boat in a compartment 4 ft. 6 in. long, which leaves the whole cockpit of the boat free from machinery, oil, and odor, and puts the engine noise behind the passengers.

This is made possible by the use of an inboard-outboard drive, of which there are several makes on the market. The drive unit has a short horizontal upper shaft which extends in through the transom and connects through a flexible coupling to the marine reverse gear bolted to the flywheel flange of the engine. At its outer end, this shaft drives through bevel gears to a vertical shaft, which in turn drives the short propeller shaft through another pair of bevel gears. The drive unit turns for steering, and is hinged (with a shear pin) so that it can swing up if it hits anything, or for beaching the boat.

Such an arrangement avoids two troubles commonly encountered where automobile engines are used in boats with the conventional inclined shaft drive—oil leakage, caused by the fact that automobile engines are not equipped with oil seals suitable for the degree of inclination required; and the necessity of mounting the engine abnormally high in the boat because the flywheel is at the driving end.

Front and rear engine brackets were cast in gray iron from simple patterns made of ½-in. pine, and attached to the original mounting holes in the engine.



Explanatory drawings made by Mr. Papworth, who won third prize in our Auto Engine Contest

mounted on a small pump bracket, held by the same cap screws which hold on the camshaft gear cover plate, and is driven by a V-belt, which also drives the generator. The suction for the vacuum fuel tank is obtained by tapping into the suction side of the water pipe, just below the pump.

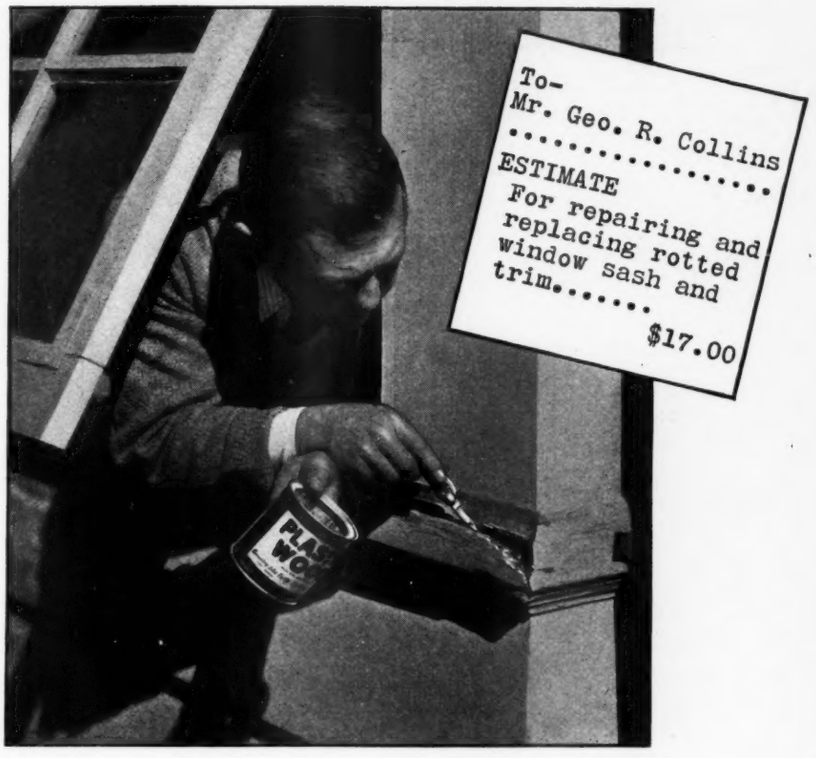
AN OIL cooler is quite necessary. In this case, the oil return tube was cut in two, straightened out, and welded into a piece of 2-in. pipe held horizontal just below the pan flange by a pair of sheet metal clips, also welded to the 2-in. pipe and held under two of the pan screws. Caps were screwed on the ends of the 2-in. pipe. First, however, they were bored to the outside diameter of ½-in. brass pipe. A straight length of brass pipe, threaded on both sides, was slipped through the caps and strongly soldered to them. At the stern end, a good vertical check valve was installed to keep the system full of water and the pump primed. Behind this, a tee was installed, the side branch having a valve threaded for the connection of a hose to pump out the bilge; and the main line aft of the tee was also equipped with a valve to regulate or cut off the direct intake of water from outside. From this valve the water intake goes out through the transom, then down below the planking, and terminates in an ell that opens forward. It will be seen that the installation avoids all openings through the boat bottom, either for the shaft or for water connections.

From the front end of the oil cooler, the water pipe goes up into the pump, with the vacuum tank suction entering through a tee, thence through ⅜-in. pipe (the pump size) around to the water inlet in the side of the cylinder block, dipping below the breather pipe, and having a drain plug at the tee just below the water inlet casting. The water coming from the cylinder head enters a ½-in. pipe line, which runs close along the top of the exhaust manifold, and down and into the rear end of the manifold just above the clamped connection to the exhaust pipe. Lacking a water jacketed manifold, a sheet metal shield covering both the exhaust manifold and this water pipe gets rid of some of the heat. Aluminum castings were used for the connection of water pipes to cylinder head and block, but flat tapped plates can be used at a slight sacrifice of neatness.

FOR getting the oil out of the crank case, the drain plug was tapped for ⅛-in. pipe and a line run to the side and above the oil level so that it can readily be pumped out. To make it possible to actuate the switch on the starting motor from a remote control, the control rod bracket on the rear of the engine can be worked over into a starter lever bracket by cutting off its vertical arm, then heating the other arm red hot and bending it downward through about 180 deg. to provide a fulcrum for a lever bearing on the starter switch plunger, which can be actuated by a pull wire from a forward steering position. Remote controls for the throttle and choke can readily be contrived with bell cranks and rods. An automatic spark control, commercially available, fits in the timer and avoids the necessity of remote control for the spark.

The flange was cut off the front end of the exhaust pipe and welded into a 2-in. nipple, thence to starboard through a forty-five, thence aft through an ell to another ell near the transom, thence to starboard to another ell as near the side as possible and above the water line, thence out through the transom with a short nipple, draining aft all the way.

This power plant is not suitable for light speed boats of the type usually powered with outboard engines. It will weigh around 600 pounds and will not deliver any more power than the larger outboards.



"I fixed it myself with

PLASTIC WOOD

and SAVED $16"

"Whoever put that quarter-round moulding on the window sill outside our sleeping porch did a bum job", writes George R. Collins. "Water leaked down behind the moulding and into a pocket. A considerable section of the sill rotted away, and caused one of the corner posts of the porch to sag slightly so that it was difficult to shut one of the porch windows. One man wanted $17.00 to put in a new sill. Maybe that's a fair price, but a small can of Plastic Wood made the old sill as good as new.

"I did it myself for $1.00—the price of a pound can of Plastic Wood. After scraping away all the rotten wood, I applied Plastic Wood in layers, waiting till each layer dried thoroughly before putting on the next application, and then painted it to match the woodwork. My wife is proud of me—but Plastic Wood deserves all the credit."

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Shows you many ways to save money with

PLASTIC WOOD

Send for this FREE 48 Page Book today. It's crammed full of facts and pictures that tell you of many ways you can save money by using Plastic Wood. It covers all those annoying repair jobs that pop up unexpectedly in every house—and shows you how to fix them permanently and economically. Send for it now and keep it handy—you'll find many uses for it throughout the year.

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Plastic Wood is *actual wood*—and yet you handle it like putty! Even if you've never used it before, you'll find it easy to do expert finishing and repair work with this amazing preparation. It's a household necessity with handy men, because they can depend on Plastic Wood for doing a thousand odd jobs—and doing them all perfectly. Comes in 9 different colors—on sale at all good hardware, paint and department stores in cans or tubes. Try it today.

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Send me—free—Big Book of Uses for Plastic Wood.

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Tested again and again, Nicholson Files come to you with the extra quality and stamina which mean faster cutting, greater durability, larger production profits on each filing job.

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FILES
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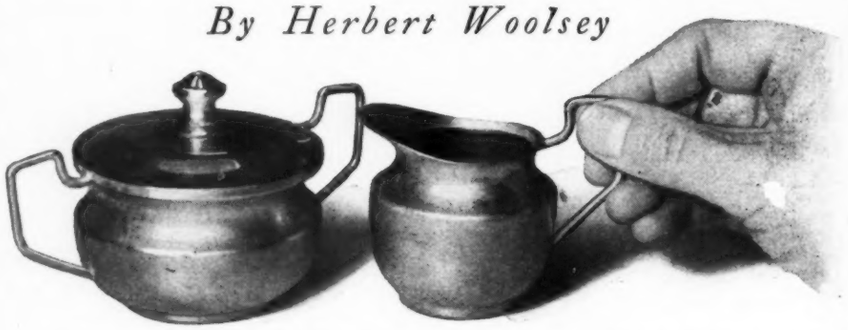
Spinning Metal

WITH SECTIONAL CHUCKS

By Herbert Woolsey



This sugar bowl and cream pitcher were spun from copper, fitted with handles, and chromium plated. The lid of the sugar bowl, knob and all, was formed from one piece

SECTIONAL chucks employed by the metal spinner are forms that can be taken apart and removed piecemeal from the inside of work of such a shape that a solid chuck could not be withdrawn from it. Cream pitchers and sugar bowls with sides greater in diameter than the opening are familiar examples of work requiring sectional forms. Other examples include automobile hub caps, an endless variety of hollow knobs, teakettles, and similar utensils.

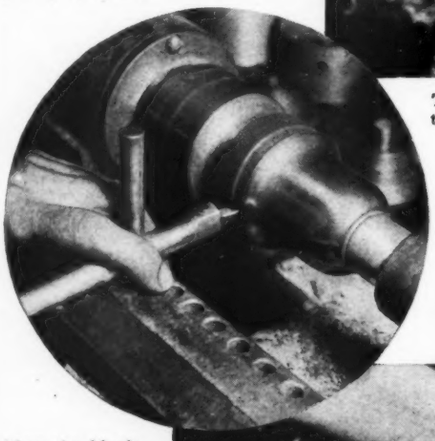
Although sectional chucks used by the professional spinner are ordinarily made of metal, they can be constructed of hardwood. The parts are designed so that the largest piece can be removed from the work after it is spun. The pieces are glued together with a layer of paper between the joints; that is, a strip of paper is coated on both sides with glue and used to join two pieces. The completely glued-up block, in the form of a disk or cylinder, is placed in the lathe and turned to the desired shape. The pieces are then knocked apart, the paper making it fairly easy to separate them.

Because metal sectional chucks are more satisfactory, the making and using of a typical one will be discussed. The example chosen is a tiny pitcher that holds enough cream for a cup or two of coffee. Such a pitcher also makes a toy that will please any little girl.

The production of the pitcher is a two-step process, as are the majority of spinning jobs performed on sectional chucks. The

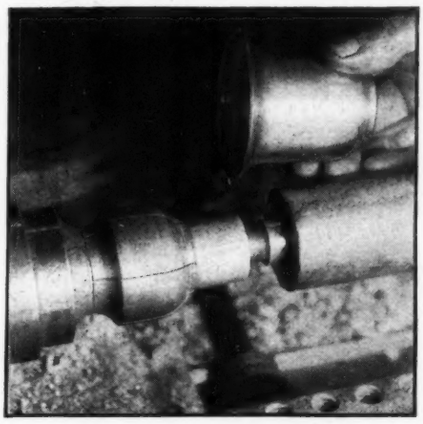
The one-piece form, or starting chuck, used in the first stage of spinning the small pitcher

first spinning is done on a chuck from which the work can be removed, and so shaped that no further spinning of the bottom and part of the sides is required. In other words, the lower half of the pitcher is made on a one-piece chuck, and subsequent operations are performed on a sectional chuck. The chief reason for this is that the portion of the work already spun serves to hold together the various pieces making up the sectional chuck while the job is being completed.



After the blank for the cream pitcher has been partly spun around the starting chuck, the edge is trimmed as shown above. Next the sectional chuck is set up, its segments being placed around a steel core as shown at right

After making the first chuck, turn out a core for the sectional one, using steel stock. This core is merely a cylinder. Its diameter should be about ¼ in. less than the diameter of the pitcher opening. At one end of the core a shoulder is left, as shown in the diagram on page 79, and in this a ⅛-in. groove is cut to a depth of about ⅛ in. This shoulder also contains the

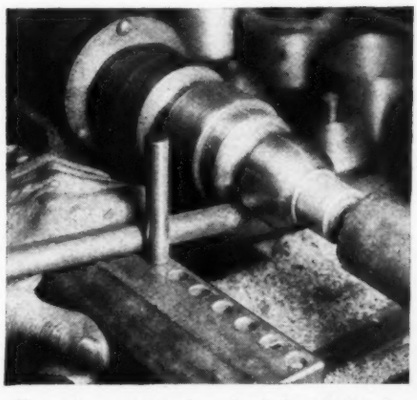


Set-up to show how the segments are grouped about the core. The partly spun blank, of course, would really be put over the chuck before the adapter button is pressed in place

threaded hole used for mounting the chuck on the lathe.

Now obtain a piece of brass—a piece of brass rod will do—of a length equal to that of the pitcher core, measured from the bottom of the groove, and of a diameter slightly greater than that of the inside of the finished pitcher at the widest part. Drill a hole, about ¼ in. in diameter, lengthwise through the piece. Saw the rod into longitudinal sections, somewhat like slicing a round cake or pie, except that the slicing must be done in a manner that will permit the pieces to be disassembled inward. In other words, the cuts separating the sections of the ring must be made in such manner that at least one piece—the key piece—will drop down away from the work when the form is to be removed.

Smooth the sawed surfaces of the pieces, making them perfectly flat, and solder them together in their original places. The drilled hole absorbs whatever differences in fit resulted from sawing and polishing the surfaces. Then chuck the piece in a lathe and bore the central hole so that it will fit the core of the spinning form snugly, but not too tightly. Next mount it on a mandrel and turn the outside to conform to the inside contour of the pitcher. At the mouth end, turn a flange



How the constricted neck of the pitcher is finally spun down around the sectional chuck

to such dimensions that it will fit inside the groove previously formed around the core. Heat the brass ring to melt the solder, and wipe the surfaces of the sections clean. The sectional chuck is now complete.

Cut the sheet metal blank as usual, and spin it to conform to the first or one-piece chuck. Then mount the sectional chuck on the lathe, place the brass pieces in their proper positions around the core, and hold them with one hand while you *(Continued on page 79)*

Know what's
Under the Hood?

Then you've a conscience about the motor. Here is a tip on operating efficiency by the service manager of a garage in Nebraska:

"It has become a byword along Auto Row that Quaker State is the best oil obtainable. The repair job we recently completed on a 3/4-ton Dodge truck that had never used anything but Quaker State convinced us again. After 30,955 miles, we found the cylinders worn only 0.0025 of an inch, and the main and connecting rod bearings were OK throughout. In 14 years of experience in automobile service work, I have never seen such perfect lubrication. Inasmuch as not a drop of any oil other than Quaker State was used in this motor, we must take off our hats to Quaker State as the peer of them all."*

Ordinary motor oils average one quart or more of "light-end" oil per gallon. This portion burns up in high-speed, high-compression cylinders after a hundred miles or so . . . blows away.

Quaker State removes this light-end material . . . at the refinery. It never reaches your motor. Every gallon of it is four quarts motor lubricant, net. Its use is the true economy in motor oils.

Look for the Quaker State sign . . . you will find it displayed everywhere you go. Most places now supply Quaker State from the patented green-and-white drum . . . double-sealed at the refinery.

QUAKER STATE
MOTOR OILS
and Superfine Greases

Price now **30c** per quart except in several high-freight areas of Rocky Mountain States.

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No matter what make, model, age, or condition, we'll give you a big, generous allowance for it when traded for one of our new 1933 models. For full information about this sensational, 50th Anniversary, money-saving plan, write us at address shown below, giving make, model, and approximate age of your old air rifle. Do it NOW before the offer expires.

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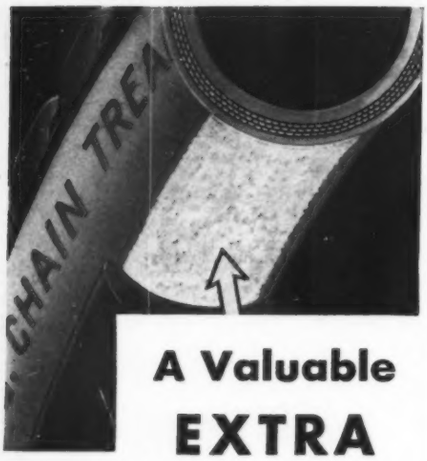

A Valuable EXTRA

that Saves your Tires —and Costs you Nothing

Even if a tire makes swell marks in the mud it's not much of a tire if it creeps on the rim and pulls valves out by the roots.

In other words, look at the *rim side* of a tire as well as its tread. On a U. S. Giant Chain Tread (or any other U. S. Tire) you'll find a Flannelette Rim Strip built right into the tire. It's put there to make a better bond with the rim—it prevents creeping—and, with proper rim cement, not shellac, you'll never have trouble with tires that pull loose. The fuzzy rim strip takes hold of more cement — the cement grips the rim—and the tire stays put for keeps. Which is just one of the more-for-your-money features built into U. S. Giant Chains at no extra cost to you.

Get all four of these features in the bike tire you buy . . .

1 **Construction . . .** three strong plies all the way around (not just 2 plies and a breaker strip) — deep, buttressed tread of toughest crude rubber known.

2 **Rim Grip . . .** flannel strip makes possible grip that prevents creeping, eliminates separation of tire from rim. (On *all* U. S. tires.)

3 **Non-skid Tread . . .** specially designed to give greater non-skid safety under all riding conditions.

4 **Appearance . . .** sidewalls are *permanently* white, treads *permanently* black — tire always new-looking.

Every one of these features means more miles — less trouble — *more for your money!*

United States Rubber Company

World's Largest (US) Producer of Rubber

All U. S. Tires always have this seal

U.S. Giant Chains with the **GRIP** that *never* slips

Our CONSTRUCTION KITS

Will Save Your Time

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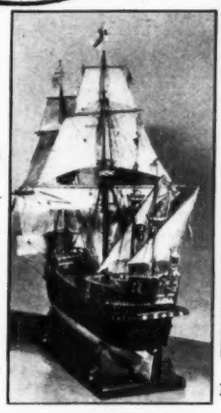
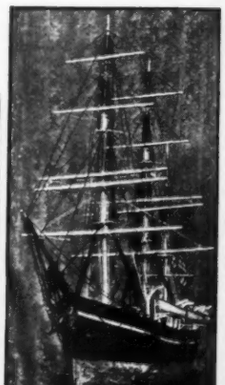
KIT D

KIT NO. 4

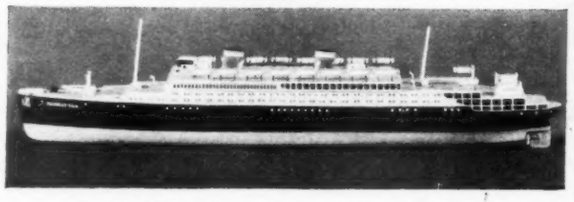
NO. 2



KIT G



KIT A



KIT F—Materials for 12-in. model of *Manhattan*

A CAREFULLY selected, timesaving kit of raw materials for building a picturesque model of the famous Elizabethan galleon *Revenge* is the latest addition to the construction kits offered by the Popular Science Homecraft Guild.

The new kit, marked *G* in the list below, contains a plywood centerboard sawed to shape and two plain white pine side blocks for making the hull, all the necessary thin plywood, chair caning spline, hardwood for small fittings, celluloid, dowels, wire, rigging cord, sailcloth, silk, beads, brads, pins, escutcheon pins—in fact everything but glue and paints. If, in addition, you wish the two main side blocks of the hull shaped and finished, order the kit marked *GG*.

The other kits available are also shown in the following list. Each is accompanied by instructions or blueprints.

A. Whaling ship model *Wanderer*. All the raw materials—wood, wire, fishing line, chain, celluloid, and everything but the paints, together with Blueprints Nos. 151, 152, 153, and 154. The hull is 20½ in. long....$6.90

AA. Same with hull lifts sawed.... 7.40

D. Spanish galleon ship model, 24 in. long. All the raw materials (except paints), Blueprints Nos. 46 and 47, and a booklet.... 6.45

DD. Same with hull blocks shaped.. 6.95

E. Battleship model, U. S. S. *Texas*, 3 ft. long. All the raw materials (except paints) and Blueprints Nos. 197 to 200..... 6.95

EE. Same with hull lifts sawed.... 7.45

F. Liner *Manhattan*. All raw materials (except paints) for a simplified miniature model 12 in. long, and Blueprint No. 204.. 1.00

G. Elizabethan galleon *Revenge*. All raw materials (except paints) for a model 25 in. long, and Blueprints Nos. 206 to 209.. 6.75

GG. Same with hull blocks shaped.. 7.25

No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble..... 5.90

No. 3. Tilt-top coffee table in selected maple with top 19 by 28 in., and 21 in. high. Ready to assemble..... 7.15

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble..... 5.30

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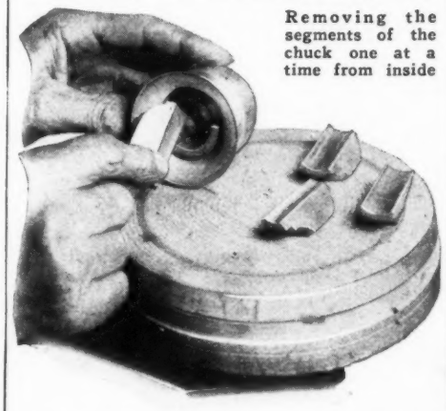
SPINNING METAL WITH SECTIONAL CHUCKS

(Continued from page 77)

slip the partly spun work over the end. The contour of the right-hand half of the one-piece chuck should coincide exactly with that of the corresponding part of the sectional form, so that the part of the work already spun will hold the sections together tightly.

Run the tailstock button against the bottom of the pitcher and complete the spinning.



Removing the segments of the chuck one at a time from inside

Then slide the pitcher and sectional form off the steel core, and you can remove the pieces with your fingers or pliers, since one of them has been designed to slip inward and free the others.

In spinning the pitcher, or rather in making the forms, allow for enough projection to form the lip. Trim the top to its final shape with tin snips and finish by filing the edges smooth. When several pitchers are to be made, prepare a template for marking the top edges. Make a handle of heavy wire or flat stock and solder or rivet it in place.

In a similar manner, the sugar bowl illustrated on page 76, with its lid of matching design, may be made.

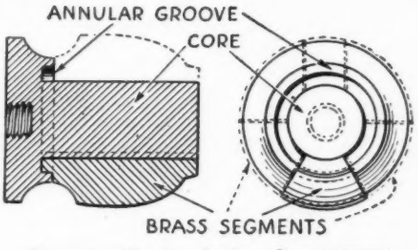


Diagram of the chuck. One segment, the key piece, is designed to drop inward

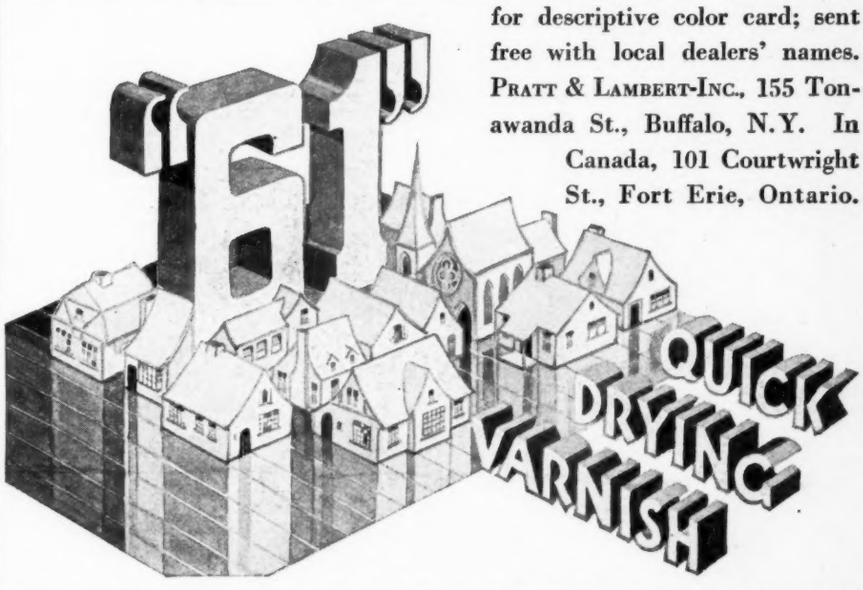
The pitcher and bowl will give years of service if chromium plated. Doubtless an enterprising spinner could find a market for several dozen sets at a price of a dollar or two a set.

This is the fourth of a series of articles that began in the March issue. The fifth article will explain other spinning jobs.

TRAINING VINES OVER A CONCRETE WALL

If you have ever tried to drive a nail into a concrete surface to train climbing roses or other plants, you know how difficult it is to do. Instead of nails, use the heavier grade of phonograph needles, which can be bought for ten cents a hundred. Hold them while being driven by pushing them through the end of a short piece of leather shoe lace or something similar.—R. G. Brown.

acres of floors from coast to coast, retain their lustrous beauty for years, without rubbing or polishing, because they are finished with "61" Quick Drying Varnish—the floor finish that eliminates drudgery. Constant renewal is not necessary. No care is required except the use of a dry cloth or mop for cleaning. You can wash it with soap and water if you wish. "61" QDV floors are *safe*—no danger of slipping or injury. "61" QDV renews and brightens linoleum, furniture and woodwork. It is heelproof, marproof and waterproof. Sold by paint and hardware stores in glistening Clear Gloss, the popular Dull Finish and four rich woodstain colors. Write for descriptive color card; sent free with local dealers' names. Pratt & Lambert-Inc., 155 Tonawanda St., Buffalo, N.Y. In Canada, 101 Courtwright St., Fort Erie, Ontario.



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New projects are marked with an asterisk (*)

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by a special reprint of the instructions originally published in the magazine. If you do not wish this reprint, omit the letter "R" from your order and deduct 25 cents from the price given. Reprints alone are sold for 25 cents each.

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(See page 78 for kit of materials)	
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MASTS AND YARDS FOR THE *REVENGE*

(Continued from page 67)

can be painted white and red. Glue them down neatly and securely on the crosstrees.

In the bottoms of each top are cut a hole for the masthead, another for the heel of the topmast, and a long slot each side to pass the rigging through. At the edges are drilled holes for the extensions of the topmast rigging.

At the mastheads are the caps, to restrain the topmasts. They can be made of ⅛-in. fiber board, celluloid, or hardwood. They have the following holes: a round one for the topmast, a square one for the masthead, and a small one each side, at the fore and main, for the topping lift blocks.

At the fore and main, fasten a ¼-in. block to lie between the trestletrees, forward, and do the same aft at the other masts. To the mainmast near the deck, fasten a cleat on either side. Drive a small nail into the foresides of both the main- and the mizzenmast to restrain the stays. The masts can now all be erected.

Because they are awkward to get at afterwards, the lower yard halyards should be rove off now. To one end of a heavy cord fasten a heavy block as shown in the photograph of the knight used on page 89 last month. Pass the other end through the block on the mast and leave plenty of the end loose. Now reeve off the tackle from medium size cord, starting at the eyebolt in the knight, through the three holes above and below, and finish by tying to the top of the knight.

For the forestay *7*, reeve the bight of a cord through the top and behind the masthead; then lay the two parts together by twisting *each* part, until about an inch from the bowsprit, and there turn in a deadeye. To the bowsprit fasten another deadeye and join together tightly with a lanyard of thin cord.

The mainstay *8* will be the same, except that the lower deadeye is restrained by a cord which passes through the hole in the stem. The deadeyes lie just abaft the foremast. The mizzen and bonaventure stays *9* and *10* are similar and fastened to nails in the masts.

(To Be Continued)

KEY TO RIGGING

To save space the following abbreviations are used:

bkstys.	backstays	Miz.	mizzen
Bv.	bonaventure	shds.	shrouds
F	fore	spsl.	spritsail
hal.	halyards	T	top
L	lower	TS	topsail
M	main	TG	topgallant

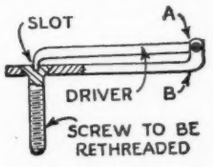
The cord and block sizes are indicated by the small letters following the name of the line. Cord a is equivalent to No. 18 (B. & S.) gage wire; b to No. 22 wire; c to No. 30 wire. Blocks d are ¼ in.; e, 3/16 in.; f, 1/8 in.

1 F mast
2 M mast
3 Miz. mast
4 Bv. mast
5 Bowsprit
6 Gammoning a
7 F L stay a
8 M L stay a
9 Miz. L stay a
10 Bv. L stay a
11 F and M hal. a, b, d
12 Miz. and Bv. hal. a, b, d
13 F L shrouds a
14 M L shrouds a
15 Miz. L shds. a
16 Bv. L shds. a
17 F and M crosstrees
18 Miz. and Bv. crosstrees
19 F and M tops
20 Miz. and Bv. tops
21 F T mast
22 M T mast
23 Miz. T mast
24 Bv. T mast
25 F and M caps
26 Miz. and Bv. caps
27 F and M T mast crosstrees
28 F and M T mast caps
29 F T mast stay a
30 M T mast stay a
31 Miz. T mast stay b
32 Bv. T mast stay b
33 F T mast shds. b
34 M T mast shds. b
35 Miz. T mast shrouds b
36 Bv. T mast shds. b
37 F T mast bkstys. a, b, d
38 M T mast bkstys. a, b, d
39 F TG mast
40 M TG mast
41 F TG stay b
42 M TG stay b
43 F TG shds. b
44 M TG shds. b
45 F yard
46 M yard
47 F sail
48 M sail
49 F clew line c, f
50 M clew line c, f
51 F sheet b, d
52 M sheet b, d
53 F bowline c
54 M bowline c
55 F topping lift b, e
56 M topping lift b, e
57 F TS yard
58 M TS yard
59 F topsail
60 M topsail
61 F TS clew line, c, f
62 M TS clew line, c, f
63 F TS bowline c
64 M TS bowline c
65 F TS hal. a, b, d
66 M TS hal. a, b, d
67 F TS sheets, b
68 M TS sheets, b
69 F TG yard
70 M TG yard
71 F TG sail
72 M TG sail
73 F TG bowlines c
74 M TG bowlines c
75 F TG hal. b, c, e
76 M TG hal. b, c, e
77 F TG sheets c
78 M TG sheets c
79 Miz. yard (lateen)
80 Bv. yard (lateen)
81 Miz. sail
82 Bv. sail
83 Miz. tack b
84 Bv. tack b
85 Miz. sheet b
86 Bv. sheet b, e
87 Bv. bumpkin
88 Miz. span b, c
89 Bv. span b, c
90 Spsl. yard
91 Spritsail
92 Spsl. sheets b
93 F braces b, d
94 M braces b, d
95 F TS braces b, e
96 M TS braces b, e
97 F TG braces c, f
98 M TG braces c, f
99 Spsl. brace lifts b, e

Note: Parts 17 to 20 are put on the masts before the masts are erected.

RETHREADING FLATHEAD MACHINE SCREWS

It is sometimes necessary to run a die over the threads of machine screws so that they will go into a tapped hole. This is difficult to do quickly unless some convenient method is devised for holding the screw. The little tool illustrated will hold either flat- or roundhead screws so that the die may be rotated in a chuck on the lathe and the thread quickly cut. It is made by turning up the end *B* and hinging the driver at *A*. In the front end a hole is countersunk to suit the angle of the screw head, and the hinged driver is made to fit the slot.



A simple holder for rethreading screws

The device is held in the right hand of the operator with the thumb resting on the driver. To remove the screw, the driver is thrown back out of the way.—George J. Murdock.

HEAT SOFTENS WINDOW PUTTY

When it is necessary to remove glass from a window and the putty is found to be so hard that it cannot be chiseled out without damaging the wood, try heating the end of an iron rod nearly red hot and running it slowly over the putty. Be careful not to touch the glass or it may crack. Softened in this way, the putty can easily be removed.—E.L.C.

PRESERVING BOOK BINDINGS

Expensive leather bookbindings can be preserved by applying a dressing of lanolin anhydrous and neat's-foot oil in equal parts. Mix thoroughly and apply with a brush, then polish the surface with a soft cloth or a lamb's wool polisher such as is used for shoes.—L.H.

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Model

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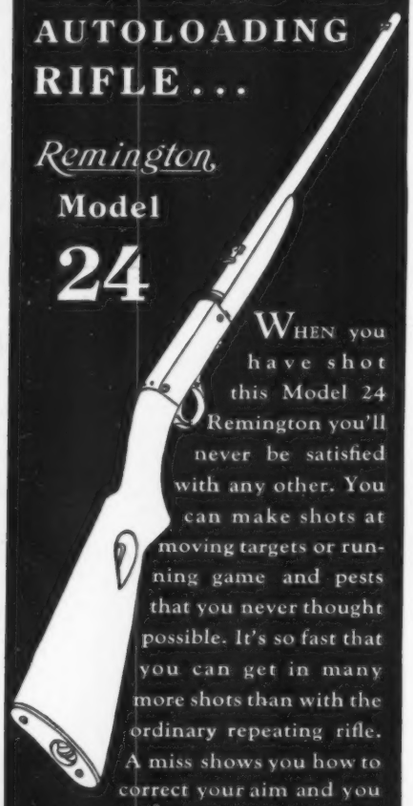

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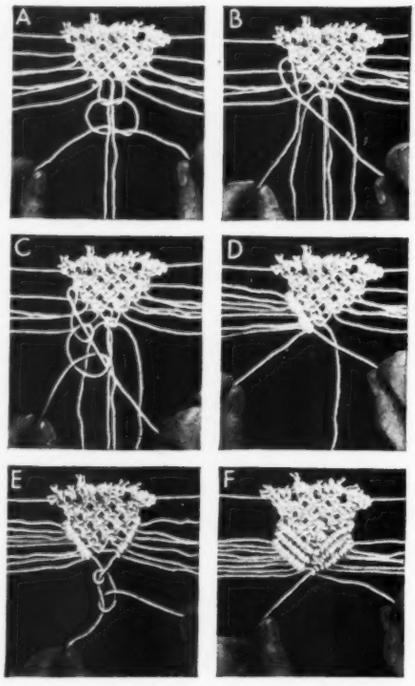


Six steps in forming a strong, well-pointed end on any wide piece of square-knot work

POINTING OFF THE ENDS OF SQUARE-KNOT WORK

THOSE who have taken up the hobby of knot work and are making belts, ties, and various original projects will find the method illustrated above an excellent one for finishing off any square-knot article with a pointed end.

Form the point first by dropping two strands at the sides of each row of knots, as shown at *A*. Then bring the top strand at one side down to the point *(B)* and tie a double half hitch around it with the second strand, as at *C*. Draw the knot up tight. Continue by half-hitching the remaining cords around the first cord to make a row extending to the point *(D)*. Do the same with the other side, and half-hitch the first, or filler, cords together *(E)*. When the three rows of half hitches are complete, as at *F*, the cord that remains is trimmed short.

This was the method used for finishing the square-knot tie described in a previous issue (P.S.M., Apr. '33, p. 75), and it can be applied frequently in this kind of work.—K.M.

For other knot-work articles see P.S.M., Nov. '32, p. 77, Mar. '33, p. 68, May p. 63.

CONDENSERS YIELD FOIL FOR MODEL MAKING

THE next time you need very thin metal foil for model making or other purposes, pay a visit to some radio experimenter. He will probably have in his junk box a defunct paper type filter condenser. These condensers are made up of alternate windings of wax paper and aluminum foil. The foil is about .00025 in. thick and from 4 to 5 in. wide. Getting at the foil is not as hard as it looks. Hang the condenser inside a tin can and place the can on a radiator or stove where there is a steady, even heat so that the wax and pitch covering will melt. When the condenser is again cool enough to handle, start unwinding the paper and foil. Do this very carefully, as the foil tears easily. Do not wind up the foil immediately, but leave it stretched out on the floor so that if there is any wax left, it will be dry before the foil is rewound.—H.S.

PLANKING AND FINISHING OUR NEW RACER

(Continued from page 63)

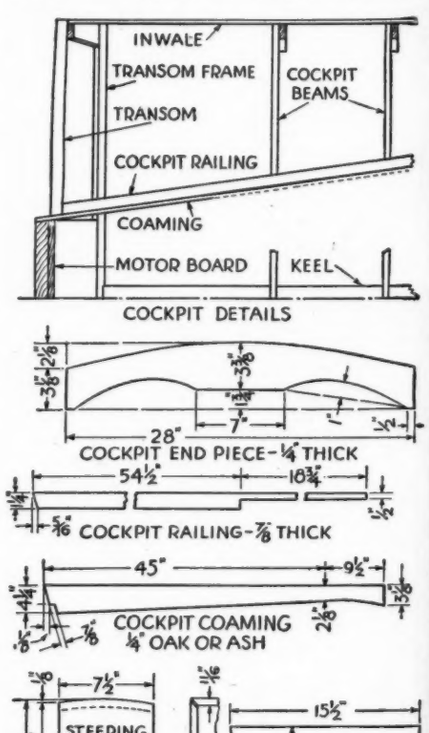
drip board and transom hook is now sawn out, fitted carefully in place, and fastened to the coaming with three 1-in. No. 6 screws to each side. The lower end is fastened to the motor board with three 2½-in. No. 8 screws, driven through from the outside. Holes ¼ in. in diameter are drilled through the transom and motor board at each corner of the drip board, and ¼-in. copper tubes inserted. Water and gasoline drippings may then flow freely overboard. If desired the drip board may be lined with sheet copper.

Attaching the steering wheel and the plywood flooring is the final job. Fasten the plywood floor to the frames with 1-in. No. 6 screws. The lower end of the wheel support is beveled and notched out for the keel, while the upper end is properly beveled to fit against the cockpit end piece and secured with three 1½-in. No. 8 screws.

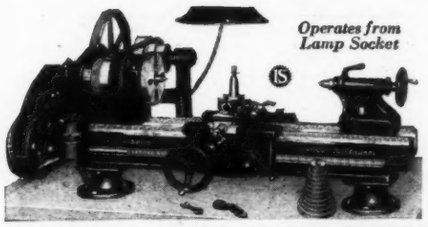
The sheer molding is attached with 1-in. No. 6 screws, spaced every 8 in. The ends of the planking at the stem are planed squarely, and a small end piece is fastened with one 1-in. No. 6 screw.

The hull is now varnished or painted according to one's preference. To have a really smooth racing finish on the bottom, three coats of hard racing bottom finish should be applied. Allow sufficient time for each coat to dry, and rub each down with pumice stone. When the final coat has been thoroughly rubbed down, apply a high-grade furniture or automobile wax in paste form and polish it well.

The installation of the steering wheel, throttle control, and fin completes the hull.



Details of cockpit railing, coaming, and end piece, steering wheel support, and drain board



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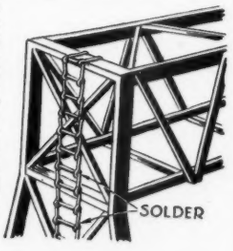
SMALL MODEL LADDERS MADE FROM CHAIN

ALTHOUGH the accompanying photograph seems to show a piece of brass "ladder" chain sticking up in the air in defiance of the laws of gravitation, it is not a lesson in magic or a model of the Hindu rope trick. The section of chain that sticks up from the fingers does so because solder has been flowed into the joints of that portion of it while it was tightly stretched between two boards.

Building miniature ladders for model railway signal bridges or semaphores from separate pieces of wire is a tiresome process. Often a piece of chain soldered along the edges in this way will serve the purpose just as well. The best type of chain, because of its straight, thin, square links and neat joints, is that found in boys' mechanical construction sets and used for motor drives. This chain will give an effect when set in place like that illustrated in the drawing.—J. G. MARINAC.



Small chain of the so-called "ladder" type may be used for making neat looking model ladders by flowing solder into the joints

PROTECTIVE PAINT FOR MARINE ENGINES

MARINE motors and automobile engines converted for marine use should be protected with a paint that will resist the destructive action of water. A good priming coat for this purpose can be mixed by adding 1½ gal. of linseed oil to 100 lb. of red lead. The linseed oil should be one third boiled oil and two thirds raw oil. If only raw linseed oil is available, it will be necessary to add ½ pt. of drier to each gallon of the paint.

The second coat is made by mixing white lead with half drier and half rubbing varnish, thinning it to an easily brushed consistency with turpentine. If desired, the mixture can be tinted with lampblack and Prussian blue. This same mixture, with sufficient varnish added to it to give the desired gloss, is then used as a finishing coat to be applied after the second coat has been sanded down. Sufficient time should be allowed between coats for thorough drying.—L. K. B.

Don't Monkey with an *Oilstoned edge*

THE foreman in the rubber factory dared me to touch the edge of his knife, but I begged off. "These short, stout knives we use on warming rolls to trim off the overhanging rubber as it comes along are *oilstoned* so sharp that you can't fool with them.

"Warm rubber is tough and clings, so the blades are lubricated with water. An inexperienced person will have the knife jerked out of his hand if he doesn't keep the edge straight and firm against the stream of rubber.

"Expert workmen," this man said, "all finish an edge of a tool on an *oilstone*. For ordinary, coarse-textured materials, whetting may do. The test is to work one day with an *oilstoned* edge. Note the greater quantity of work done, the quality of work and how much less tired and strained you are."

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SECRETS OF LIFE SEEN WITH A MICROSCOPE

(Continued from page 33)

is filled with distilled water and about fifteen drops of the hæmatoxylin is added. The specimen is immersed in this preparation and permitted to remain there for about thirty minutes. Then it is again washed in water and finally dehydrated by soaking it in alcohol for a few minutes. It is then transferred to a turpentine bath, after which it is mounted with Canada balsam on a glass slide.

When we place such a specimen under our microscope, we shall be amazed at the transformation that has occurred. In the place of the thin, shadowy outline that was first seen, we shall have a clear view of the specimen and all of its intricate and delicate details.

YOU are now ready to appreciate the wonderful methods used by industrial microscopic research workers who so treat an object that a view may be had of an entire body. If a trained microscopist wished to study the whole interior of a fly, he would not embed it in wax as we did and hack a piece off with the microtome. First he would freeze the fly solid so that its viscera would hold their shape while the thin pieces were being cut. The freezing would be done with ether spray and the cutting done on either a Rutherford or Cathcart slicer, which would cut the pieces to almost unbelievable thinness.

The scientist would not cut these sections of the body here and there at random. Instead he would start at one end and cut sections progressively all the way along the fly's body. Then he would mount the slices, starting with number one and working back through several hundred until he has seen the organs he wished to study.

There is in use today an automatic microtome that will cut a bug, or any other organism, into a continuous series of sections that are later mounted and from which may be learned the story of the bug's mechanism.

WHETHER you live inland or along the seacoast, in the summer you seek the water—to swim, to fish, to paddle your canoe, or to cruise in your motorboat or sailboat. Next month Mr. Hall will tell you how to add new enjoyment to your vacation trips by gathering the strange and beautiful microscopic creatures that inhabit lakes, rivers, brooks, ponds, and the ocean. Full instructions will be given for making your hunting equipment from odds and ends and for preparing the specimens for your microscope.

ALASKAN EXPEDITION TO STUDY STORMS

HEADING for the weather factory of the world, an expedition of 600 men representing the U. S. Navy and the U. S. Weather Bureau recently left San Diego, Calif., for a five months cruise among the Aleutian Islands, off the coast of Alaska. In those bleak regions, many of the North Pacific storms are believed to originate. Wearing special clothing to protect them from the cold and storms, members of the expedition, in two destroyers and fourteen small craft, will survey approximately 75,000 square miles of territory. The destroyers will carry sonic depth finders and the small craft will be used for sounding shallow bays and for shore-line work. In addition, two amphibians will carry on aerial photographic work. Starting near the Alaskan coast, the fleet will work westward for nearly 1,500 miles, studying the reefs, the sunken rocks and the tide rips of this island chain. Daily barometer readings and wind direction records will be sent out by radio. There data will be tabulated in an effort to determine their relation to general weather conditions.

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JIG-SAW PUZZLE SHORT CUTS

(Continued from page 61)

puzzle saw or by planing. In the latter case, lay the panel flat and face up on the bench, allowing it to extend several inches beyond the edge. Standing at left end of bench, hold the panel down firmly and against bench stop or vise with left forearm, and trim the edge with a sharp block plane held in right hand and drawn toward you. The blade must be set for a shallow cut. It will raise the edge of the picture, but remove this bur later with downward strokes of a sharp file, held vertically. If, instead, the edges are trimmed with the same blade which is used to saw the puzzle, they will show the same treatment as the other cuts, thus making the puzzle more difficult to assemble. Keep the trimmed panel face down under weights until ready to saw.

The assembled puzzle is turned face down, held tightly with cleats of the same thickness, and then sanded until smooth

A flat varnish is sometimes applied, but is not advisable. Panels so treated are harder to saw, and it serves no real purpose.

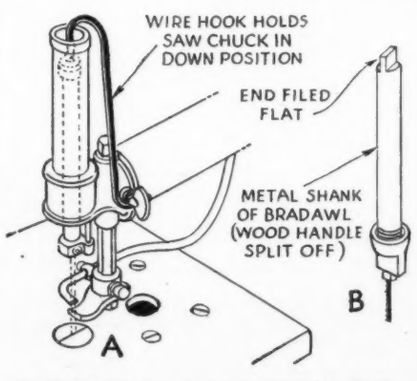
Figure Pieces. These make puzzles less difficult, though more interesting to many fans. If not well done, they are better eliminated. When but a few are needed, a master copy should be drawn and carbon copies traced on thin bond paper. If used in quantities, draw full sheets of patterns through hectograph carbon paper or with hectograph pencil and reproduce 50 or 75 copies with a cheap hectograph outfit.

Patterns may also be drawn or traced on the back of the panel and the puzzle sawed face down with the saw blade reversed. This is a slow process and the picture receives needless wear and tear from contact with the saw table.

Determine the patterns to be used on a single panel. Clip these and use rubber cement to fasten them on the face of the mounted picture. Remove surplus cement from the picture by rubbing circularly with the heel of your hand.

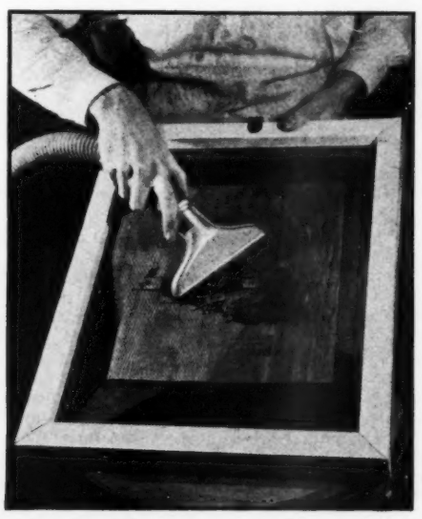
Sawing. The choice of blade is largely a personal matter. Try them at various speeds for different results. Pulleys may be built up with gummed paper tape. My choice of saw blade is one that is .007 in. thick, .028 in. wide, and has 21 teeth per inch. There is a trick in operating this blade that makes it possible to cut figure pieces with facility. When a sharp corner or point is desired, turn the panel quickly, then stop for a moment. The blade will flip around and may be lined up in the new direction before continuing.

After the figure piece has been sawed, the pattern may be peeled off with tweezers or a pocketknife. Rub off any remaining rubber cement with a small ball of the same material, which may be collected by rolling the cement from the cardboard upon which you laid the patterns while spreading cement on them. Should a pattern stick or the picture surface *(Continued on page 86)*



An aid in setting saws and an extension chuck

Pieces are counted by laying them in piles of two with twenty-five piles in each group



Two frames covered with insect screening and hinged together are used in cleaning the puzzles, which are placed between them so the dust can be quickly blown or sucked out

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JIG-SAW SHORT CUTS

(Continued from page 85)

begin to peel, soak the pattern well with benzine or cleaning fluid until the rubber is softened.

If saws are changed whenever they become dull and begin to cut slowly, the work will be improved. On certain of the newer type scroll saws, it is somewhat difficult to adjust the blade, depress the spring, and turn the set screw. Bend a piece of stiff wire as shown in the drawings at *A*. Depress the spring with one end and hook the other under the wing nut at the right side. Both hands are then left free to adjust the blade and turn the wrench.

Many saws that are removed when dull and others that break close to the work or at the lower chuck still contain sharp, new teeth in their upper part. Further good use may be had from them. Obtain a cheap awl of the type having a chuck, and split away the wooden handle so the metal shank may be removed. File the end flat, as shown at *B* in the drawings, and small enough to enter the upper chuck of the scroll saw. The awl chuck is built to accommodate a round shank and must be built up in order to hold the flat, thin saw blades. Obtain a cotter key of the proper size to enter the chuck and flatten the eye, or file a nail flat on one side and bend it double with the flat sides facing each other. Cut off the ends and place it in the chuck. This will hold the puzzle blade and, when assembled in the upper chuck of the saw, will extend that member about 2 in. Should the cotter or nail chuck jaws have a tendency to slip or drop from the awl chuck, place a bit of chewing gum in the chuck before they are inserted.

If saws are changed as soon as dull, there will be little or no bur raised on the picture surface, thus making it unnecessary to burnish the edges of the pieces.

Quantity Production. This is best attained through the well-known "strip" method. Cut the puzzles one at a time; nothing can be gained through stacking, so far as my many experiments have indicated. Build a stand with a slightly sloping top handy at the right of your saw. As the pieces are removed from the saw table, assemble them on the stand top. This method has long been kept secret, and its use will not only double your output and save much dusty labor, but it will produce a clean, unhandled, evenly sanded puzzle in a few moments' time, assuming of course, that you are making a completely interlocking puzzle. No other should be attempted.

Sanding. When sawed and assembled, as described, the complete puzzle should be turned face down and cleated rigidly with plywood strips of the same thickness. These strips are tacked along all four sides to a smooth, flat table top or panel. If used for no other purpose, two of these cleats should be permanently nailed to form a right angle at one corner of the board. Countersink all brad heads. Use two or three grades of abrasive—I prefer emery cloth tacked to blocks—and sand and polish in one operation. Sand only with the grain.

Cleaning. Build two frames of ½ by 1 in. strips of wood, large enough to accommodate the largest puzzle you expect to make. Hinge these frames together at one side and fasten insect screening to the facing surfaces of the two frames. Open this like a book, place the still assembled puzzle between the screens, close, and hook tightly. The dust may now be jarred from the cuts, or better still, sucked or blown out with a small hand vacuum cleaner or compressed air.

Counting. When the pieces are all well cleaned, break the puzzle down and lay pieces in piles of two each on a table top. Place five piles in a row, horizontally and vertically. The *(Continued on page 87)*

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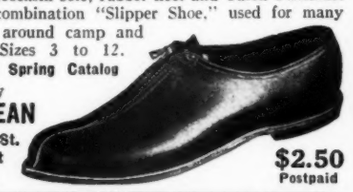

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JIG-SAW SHORT CUTS

(Continued from page 86)

square then contains fifty pieces. Minor repairs may be made during this operation, before boxing the puzzles.

Boxes. Make your own as described elsewhere in this issue or obtain empty cardboard boxes from any haberdashery. If none is available of the proper size, cut down larger boxes, reënforce with gummed paper tape or paper strips, and cover with colored paper or wall or shelf paper. All boxes should be uniform in style and color scheme. Choose a trade name and have neat, colorful labels printed.

Keep a record card for every puzzle you make and list all data such as title, date, size, number of pieces, cost, selling price, or rental schedule. My own method of renting them is to base the weekly charge upon 10 percent of the retail value of the puzzle. Thus, if the puzzle is worth $5, the rental with one week's time limit is 50 cents, and the overtime charge is 10 cents.

Lost Pieces. These are the bane of every puzzle owner. Obtain the pieces which surround the hole and fasten them together in the correct position with gummed paper tape attached to their bottoms. Lay on a smooth surface, and place a sheet of thin, white paper over the hole. Rub with a flat, smooth piece of lead. This gives an outline of the edge of the hole. Prepare a scrap of plywood by gluing a piece of good bond paper to one side. Attach the pattern to this surface with rubber cement and saw with a slow, accurate cutting saw. Then remove the pattern and paint the paper surface to match the surrounding area, using water colors or oils. After it is thoroughly dry, coat the surface thinly with flat varnish.

Finally, remember to give Uncle Sam 10 percent of the selling price of every puzzle.

Prizes for Best Family Group Photos

FROM the many excellent family group photographs submitted in the fourth of our $100 photo contests (P. S. M., Feb. '33, p. 74), the following were chosen as the best in respect to photographic qualities, general arrangement, lighting, and naturalness of pose:

FIRST PRIZE, $50
L. DeS. Dibert, Philadelphia, Pa.

SECOND PRIZE, $25
Moe Simon, Passaic, N. J.

THIRD PRIZE, $10
Cable Wagner, Sidney, Ohio

FOURTH PRIZE, $5
J. F. Kreps, DeForest, Wisc.

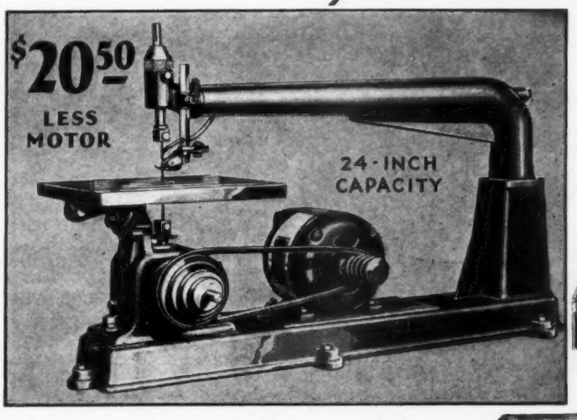
FIFTH PRIZE, $5
B. Marion Shields, Danville, Ky.

SIXTH PRIZE, $5
Henry N. Ericson, Jamestown, N. Y.

HONORABLE MENTION—*Paul R. Bergman, Spokane, Wash.; William L. Falk, New York, N. Y.; Anna Lee Fortner, Berea, Ky.; A. Lampariello, Newark, N. J.; Robert T. Gidley, Melrose, Mass.; Mrs. W. A. Miller, Cadillac, Mich.; Mrs. Violet U. Nagamine, Lehaina, Maui, Hawaii; Oliver P. Pearson, Philadelphia, Pa.; A. Reimherr, Hasbrouck Heights, N. J.; Kay Seavey, Portland, Ore.; Mrs. H. B. Schell, Somerville, N. J.; Jean L. Taylor, Chicago, Ill.*

TWO SUPERIOR JIG SAWS

Ⓢ *by "Driver"*



For business or hobby—as money-makers or means of diversion—these new DRIVER Jig Saws are unequalled! Every step in development was taken with infinite care—with one ideal in mind—to produce a *better* jig saw. Every step in manufacture is made with the same exacting diligence—to see that ideal realized in the finished tool. Call at your local DRIVER store and inspect the new models—there's no obligation.

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SINCE every story of success reads like a fairy tale these days, I'd better begin in the accustomed manner. Once upon a time I was a commercial artist. I worked for a large concern, and was one of twelve thousand employees. The work was routine, and advancement purely a matter of seniority—but, at least, the position was secure.

That was—until October, 1929. Then came the crash, and with it, the order to cut expenses. 1300 employees were weighed in the balance and found unwanted. There followed six months of pavement pounding, finally ending in my signing up as a deck-hand on a red and rusty lake freighter. It was a job, and I stuck it out until lake navigation closed down the following winter. Then the outlook became gloomier than ever.

In February I was visiting a neighbor. His wife happened to say she wanted a silhouette of their young daughter. More for amusement than anything else, I drew a rough sketch on an old letter. They seemed delighted. I took it home and finished the job on Strathmore paper. They ordered three copies. The news spread, and soon others requested sittings. That was the turn of the tide.

I spent hours in the Public Library, reading books on silhouette drawing, appreciation and collecting. I studied the handiwork of long dead artists; called at every home where I even suspected they had portrait silhouettes. Then I put my heart and soul into the task of producing better and more life-like silhouettes than had ever been made before. People were pleased—my business showed that.

I packed a suitcase and set out on the road. Establishing myself in a store, I called personally on every family in the community, showed my wares and invited them to the store for sittings. The price was one dollar a head. They came. The average daily run was six sittings. On one never-to-be-forgotten day in Iowa, sixty-one people were drawn. The store had to be kept open till eleven at night to accommodate the crowd!

PEOPLE wanted frames for their silhouettes. Most of those on the market were abominable, and the good ones were prohibitive in price. I felt certain I could produce an attractive oval frame to sell for one dollar.

Returning from the road, I sent to various firms *(Continued on page 89)*

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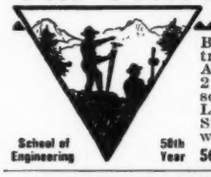

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Secrets of Success

COMMERCIAL ARTIST NOW GLAD HE WAS "FIRED"

(Continued from page 88)

advertising in POPULAR SCIENCE for price lists on woodworking machinery. Risking every cent I had, I ordered a direct drive shaper, jig-saw and circular saw. One month later my tiny shop was in production, turning out beautiful ovals of walnut, maple and mahogany. I made a profit at a dollar a sale.

The humble start of drawing a picture to please a friend has, in two years, grown to be a most interesting and useful occupation. I am happier today, controlling my own destiny, than ever before. Go back to the old grind?—Not on your life—even if it were possible.—A. M., Chicago, Ill.

• • •

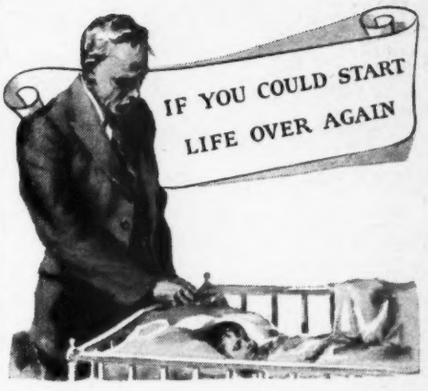
THIS FARMER IS MAKING MONEY IN HARD TIMES

HERE is a story of success which does not conform entirely to the rules under which this department is run. The success of the man who tells the story did not come about through education or particular fitness for the job. Still, there are two good reasons for printing it. One—the amount of hard work and application represented in the success, and two, the fact that a farmer, with enough foresight, can make money, even in these days in which the farmer, as we know, is hardest hit of all.

I own and operate, with my son, an average sized farm, near Tiffin, Iowa. Nobody has been hit harder than the Iowa farmer. When produce prices began to fall below a certain point, and our fixed expenses, such as mortgages and taxes, remained practically the same, we saw that it would be necessary for us to change our farming and marketing methods. Otherwise, we might just as well not have the farm.

Not only were grain prices becoming ruinous, but also the land was run down and needed a rest. Even in a normal market, we couldn't have produced enough to make a go of it. Under these conditions, live stock was an unjustifiable expense. So we decided to butcher our hogs and beef. We live about ten miles from a good market, and the roads between aren't bad. Take our beheaded beef to that market, we thought, and it will be more profitable than feeding it as live stock.

Neither one of us were butchers and we realized there *(Continued on page 90)*



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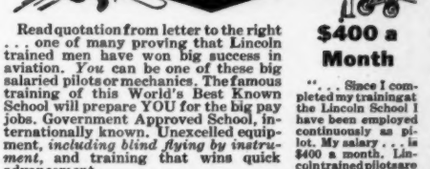

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Secrets of Success

THIS FARMER IS MAKING MONEY IN HARD TIMES

(Continued from page 89)

would be much to learn. We wrote to the Department of Agriculture, at Washington, and to the State College. In reply, we received a number of booklets on butchering and curing meats. After weeks of reading and study, we were ready for our first experiment—pork. We found that handling and selling one hog took exactly one week. This didn't seem very fast for the amount of work put into the job. But we were very careful about being clean, and our trade increased slowly. Sausage was our specialty, and the restaurants in town began buying it in increasing quantities.

This year we began to sell some beef, and found it offered a great deal more work than selling pork. There was much more of it to dispose of in small amounts. Our meat was tender and fresh, and we handled and wrapped it with every precaution. Now we have a fair trade among eating houses and tea rooms. We have just finished our last butchering job this week, as it will soon be warm weather, and we intend to raise potatoes and other truck to sell this Spring and Summer to our same trade. This will assure us of a reasonable amount of business.

It means, as you can see, a great deal of work. Its reward is in keeping us going till prices start to rise. We don't call it financial success, but it has been the means of securing for us a small and fairly steady income, where before we had the prospect of looking forward to nothing at all.—J. I. E., Tiffin, Iowa.

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THATCHED ROOF COVERS BIRD HOUSE

HERE is a bird house that birds like. During its first season, two sets of bluebirds were hatched in the original house shown in the photograph.

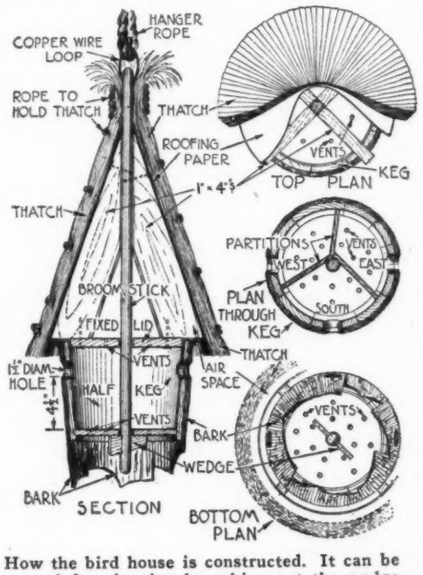
The only piece of lumber required is a 5-ft. length of one-by-four. Everything else can be picked up. The thatching for the roof and the strips of bark which are used to finish the sides may be gathered along almost any roadside woods or stream. Broomsticks are easy to obtain, and any hardware store has empty nail kegs. An empty fruit box from the corner grocery, a short length of old clothesline, and a 2-ft. strip of roofing paper (ready roofing) complete the bill of materials. Scraps of sheet metal or thin strips of wood that will bend readily (such as fruit box sides) might be substituted for the roofing paper if the latter is not readily available.

Dried cat-tail leaves make good thatching (rye straw is the old-time favorite), but gather plenty of them as they shrink in drying. Hickory bark is excellent for the sides, but any durable bark will do. Although adding to the attractiveness, the bark and thatching are used also to protect the interior from extremes of temperature.

This bird house is of the hanging type, which is preferred by many birds because it offers security from cats and other natural enemies. It is made in two sections to facilitate cleaning at the end of the nesting season.

For the lower portion, cut a nail keg in half. At the center of the bottom bore a 1-in. hole to receive the end of the broomstick. Also bore a dozen or so ¼-in. holes in the bottom for ventilation and drainage. Now tack strips of bark to the outside, allowing the rough and jagged ends to extend several inches below the bottom as shown.

For bluebirds, bore three 1½-in. holes in the sides, locating them 4½ in. from the bottom of the keg—one each facing east, west, and south. More than one pair of bluebirds may not be expected to occupy a house



How the bird house is constructed. It can be opened for cleaning by taking out the wedge

at the same time, but each pair will raise two successive broods in the same house if fresh nesting compartments are available. The three nesting compartments are equally divided, as shown in the plan view, by means of partitions made from fruit box sides.

Now for the upper section: The fixed lid, as shown in the sectional drawing, is a disk sawed from an end of the fruit box so that it fits the inside of the keg loosely. Bore the lid to correspond with the holes in the bottom

This well-insulated, attractive, but inexpensive bird house was designed by an architect

of the keg. To the lid nail rafters made from the 1 by 4 in. lumber; the rafters, in turn, are nailed to the broomstick, which should be about 3 ft. long. The rafters are cut on a bevel to fit against it as shown, and at the foot they are cut horizontally to fit snug against the lid.

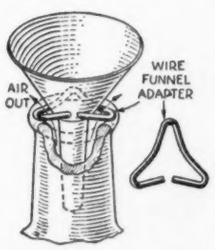
Fasten the roofing paper to the rafters to form a cone-shaped foundation for the thatching. Apply the thatching so that it will be 1 in. or more in thickness, and hold it in place by wrapping it with the clothesline. If necessary, the rope may be prevented from shifting by tacking it to the rafters through the thatch and paper roofing. Bore a small hole near the top of the broomstick to receive a copper wire loop for affixing the hanger rope.

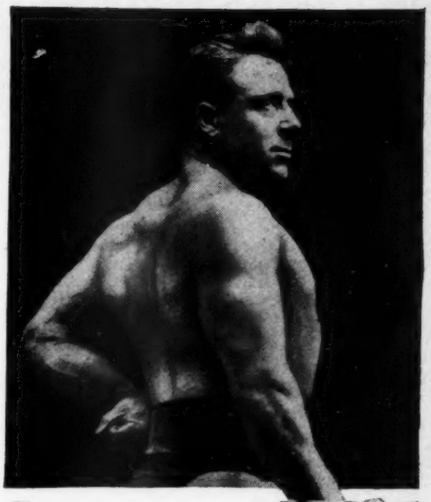
Finally, assemble the two portions by means of a wedge-shaped pin passing through a slot cut near the lower end of the broomstick. The slot may be easily made by boring two ¼-in. holes 1½ in. apart and, with knife or chisel, removing the wood between them.

If it is desired to attract wrens instead of bluebirds, make the entrance holes only ⅞ in. in diameter. And, if desired, provide more compartments by fitting in another floor, thus making a two-story house. In the latter case, use about two thirds of a keg instead of one half.—JAMES THOMAS.

ADAPTER MAKES FUNNEL FIT BOTTLE BETTER

SOMETIMES it is necessary to fill a bottle by means of a funnel that is too small for the neck. This can be remedied by bending a piece of stiff wire to the shape shown and sliding it on the spout of the funnel. It holds the funnel in an upright position even though the neck of the bottle is much larger than the spout. At the same time, it lets the air escape from the bottle, and this would not be the case if the funnel were allowed to slide into the bottle as far as it would go.—HENRY J. FRANCEFORT.





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Grinding a Mowing Machine Sickle

By L. M. ROEHL
New York State College of Agriculture

ONE of the recurrent jobs during the haying season on farms is that of grinding and repairing the mowing machine sickles. Uusually two men are needed to do the grinding with a grindstone, one to turn the stone and the other to hold the sickle.

Fig. 1. Sharpening a mowing machine sickle on a motor-driven grinder designed for farm use

On farms where electric current is available the motor-driven grinder has displaced the grindstone, and one man can do it in less than half the time required with a grindstone.

A grinder that has the grinding wheels attached to the motor shaft is not suited for this and other farm grinding. The motor interferes with holding the sickle and other work to the wheels. The machine shown in Fig. 1 is especially designed as an all-purpose farm grinder. The motor is back and down where it is out of the way, and the power is transmitted with an endless V-belt.

For sickle grinding, the regular grinding wheel, which is 1 by 6 in. and on the left end of the shaft, is removed, and the beveled sickle grinding wheel is placed on the right end of the shaft.

The sickle is held firmly in both hands on the wheel so that the right side of one section and the left side of the one next adjoining are ground at the same time. It is held on the stone lightly and moved back and forth. Holding it lightly prevents heating the section excessively. The sparks from the grinder will indicate where the grinding is being done. A sickle needs to be worked or pushed far enough up on the stone to grind down where the sections meet. It should not be drawn down so far as to grind or round off the tips of the sections. The grinding is continued until the sections are brought to an edge. The wire edge may be removed with an oilstone, but it is not serious if not so removed as it will disappear when the sickle is put into service.

A long sickle is too heavy to hold while grinding near an end. The weight may be carried on a stand placed under it or by a rope sling hanging from above.

By this method, a 6-ft. sickle can be ground in less than 30 minutes, and tests have shown that the sickle cuts better and stands up longer than if ground with a grindstone.

The special wheel for sickles should not be used for other work, as it is apt to get out of the proper shape for sickle grinding. At the close of the haying season, this wheel should be removed from the shaft and stored until again needed. If the wheel gets out of round or the surface irregular, it may be brought back to correct shape with an emery dresser.

If sickle heads become loose and need to be tightened or replaced, the rivets are placed from the bar side and riveted on the head as shown in Fig. 2. A piece of railroad rail makes a serviceable anvil for this work and for other farm purposes.

A good way to remove a section is to place it in a vise and, with the bar of the sickle resting on one vise jaw as in Fig. 3,

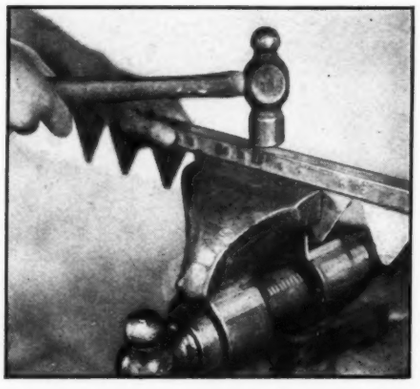

Fig. 3. Removing a section from a sickle by shearing the rivets with hammer and vise

deliver a firm blow with the hammer on the edge of the section directly over the rivet. This shears the rivet, and the section drops out.

When riveting a section in place, the rivet should not be hammered down flat, or the edges will protrude so as to catch and drag hay lengthwise of the cutter bar. This increases friction and draft. The ball end of a ball peen hammer is used for this work. The blows are directed as shown in Fig. 2, and a smooth, round head is the result.

What farm repairs would you like Mr. Roehl to discuss next in this series? Please address your suggestions to the Home Workshop Department.

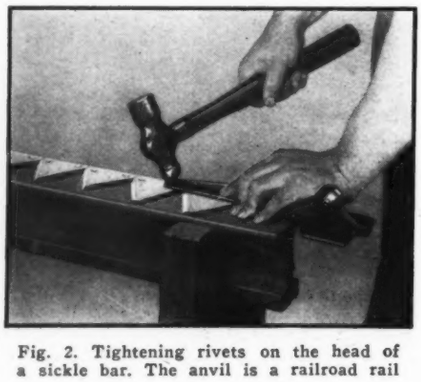

Fig. 2. Tightening rivets on the head of a sickle bar. The anvil is a railroad rail

FIREPROOF COATING FOR WOODEN ASH TRAYS

AFTER making a wooden model on several occasions, I have found that if it were lined with glass or metal it would serve as a fine novelty ash tray. Because of the irregular shape, it was impossible to use glass and impractical to make a regular metal lining. I discovered an inexpensive way of making linings simply by applying high-grade iron cement mixed with just enough water to make a stiff putty. Cover the inside of the model with a thin layer. I used this method to line the old well model described in a previous issue (P. S. M., Dec. '31, p. 84).—HARRY SCHMIDT.

SAVE OIL AND PAY FOR REPAIRS

(Continued from page 56)

car at thirty miles an hour. If you should step it up to sixty, you'd use just about seven times more oil than you're using now. That's one of the things that makes speeding expensive."

By this time they had reached the driveway to the Model Garage. Waving a greeting to the odd-job boy who was taking care of the gas and oil trade over the holiday, Gus opened the door of the car.

"Come on in with me, Paul. It'll only take a second and I think I can show you something interesting," he said.

WHEN they were inside, the gray-haired mechanic pointed casually to a small roadster partially dismantled in the center of the floor.

"What's that, a wreck?" Mathews asked.

"It's a wreck all right, but not the kind you're thinking of," Gus said. "That's a sample of what bad oil will do to a motor," he added, poking the cylinder head. "Carbon's crusted a quarter inch thick on the head and pistons. The rings are black and the valves are chewed and pitted. Besides that, the bearings are worn and the cylinder walls are scorched. And take a look at the crankcase; it's chuck full of gum and goo.

"The baby that owns that car saved plenty using cheap oil but it's going to cost him about eight times what he saved to get the buggy back in shape. Pretty expensive oil in the long run, I'd say."

"Gosh, this oil business has got me," Mathews exclaimed. "You've got to have oil and it's got to be good. Yet, you can't tell whether an oil is good or not until you've tried it—and then it's too late. What the dickens can a dumb-bell like me do?"

Gus grinned. "That's easy," he replied. "Just buy a recognized brand of oil of the right rating for your car from a dealer you know won't cheat you. You can't save yourself any money by buying cheap oil, but you can do it by being careful. For instance, don't use the choke more than necessary. Don't idle the engine or run it at top speed for long stretches. Don't flush out your crankcase with kerosene and never run your car unless it's in the pink of condition. Of course, you want to use the oil that has the right viscosity for your motor in summer and winter."

"Gus, one thing has been bothering me ever since I bought my first car." Mathews confessed. "What earthly good is that oil pressure gage on the dashboard?"

"I GUESS most car owners think it's just part of the decorations," Gus joked. "But if you know how to use it, you can tell a lot about your oil system. If the gage reads high, your oil may be too heavy or the oil line may be clogged. If the pressure shows low, the oil is probably too thin, unless there's a leak or the line's clogged. A fluttering gage needle is a warning that the oil is low."

Glancing slyly at Mathews who stood studying the gage, Gus said, "I guess I've beefed enough. It's about time we were going back along the Pike to pick up your oil."

"Not my oil," Mathews declared solemnly. "I use only good oil in my car."

WESTERN HORSE THIEF USES MOTOR TRUCK

CATTLE thieves that ride in motor trucks are the latest type of outlaw reported from the West. Horses, cows, and hogs have been stolen in this way, the trucks pulling up beside a field, hastily taking on a load of animals, and then disappearing down the highway at top speed. One truck-using horse thief was recently captured at Grand Island, Nebr., after having driven his load of animals 250 miles.

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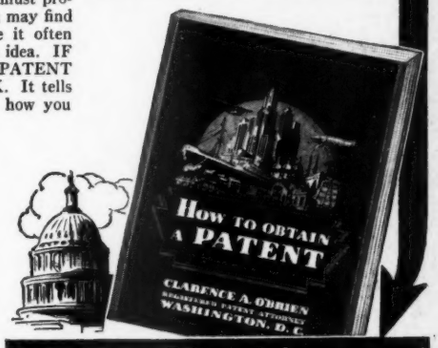

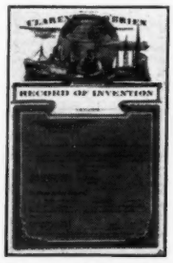

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RAISING TROPICAL FISH BIG INDUSTRY

(Continued from page 27)

stance here is an aquarium divided into halves by a glass partition. Swimming rapidly back and forth, but separated by the partition, are two identical fish. Each is flesh-colored, each enveloped in what seem to be luxuriant fringes or manes of bright red that resemble some exotic water plant. These make constantly shifting patterns, as the fish tear back and forth. Now and then they stop, glare through the glass at one another or butt their heads against it. They seem eager to fight.

So they are, for they are two male Siamese fighting fish, who had to be separated to keep them from engaging in death struggle. They are but following nature, since for many years Betta splendens, one of the most pugnacious of tropical fish, has been bred for battle. He is a hybrid, and his abundant and wavy tail and fin formations are a somewhat artificial product. They help make more spectacular the combats in which he loves to engage.

IN SIAM, men train fighting fish like prize-fighters, exhibit them in individual tanks, seeking a challenger. Then, when a match is made, the fight takes place in a large tank, elevated in the center of the crowd. Amid cheers, boos, and wagers, in a swirl of bright-colored bodies, veil-tails and fins, the fight rages, until the teeth of one have brought death to the other.

The rage for tropical fish has brought this Siamese custom to this country and fish fights have become popular. People are talking of replacing Betta splendens with a larger fighter from Guatemala, said to be more vicious.

Here in another tank, is an even rarer tropical fish, the mud springer, found in Africa. It looks like a bullfrog's head on a dragon-fly's body. It has neither legs not feet, but with powerful pectoral fins, hops over the muddy ground at the water's edge. It digs holes in the shore, and darts out to catch insects flying in the air.

Here, in a near-by tank, is an interesting visitor from Singapore and Sumatra, the Red Rasbora. This is, at the moment, one of the most popular tropical fish in America. About two inches long, its coloring is gorgeous. You may want some for your aquarium. Children delight in watching the female Rasbora swim about until she finds a plant with large leaves. To the underside of the leaves she fastens the eggs she has been carrying.

That trick does more than get rid of the eggs. It hides them from cruising hungry fish who may even include the parents. They have been known to stoop to cannibalism.

Having got your fish into your aquarium, how will you feed them? All sorts of food can be bought at the place where you got the fish, including prepared foods that are a sort of rice-flakes, or that have been treated with ultra-violet rays. Prepared foods are all right, though the best is living food; larvae, tiny insects, and worms.

Don't put more food in the water than the fish can eat. It will simply poison the water. Another don't: Don't try experiments to make tropical fish spawn. If you keep the fish well fed, and the tanks clean, the chances are they will increase and multiply. If they don't, get some new fish. And a final tip: Don't put the aquarium on a window sill, especially if the window sill is just over a radiator. An aquarium should have neither extreme heat nor draft. It needs light, but not direct sunlight. If you want to get the most enjoyment from watching your finny pets, the light must strike the aquarium from behind you.

TESTS WITH HOUSEHOLD AMMONIA

(Continued from page 49)

menting with the nitrogen you collect, you will find that it is a very inactive gas. The fact that you can collect it over water shows that it is not particularly soluble. Carefully raise a glowing splinter of wood into an inverted bottle of the gas and you will find that the ember is extinguished. Nitrogen gas neither burns nor supports combustion. Further tests will show the gas to be tasteless and odorless.

In fact, nitrogen does not combine readily with many substances and its compounds are easily decomposed. The ease and violence with which most of its compounds break down are well illustrated by two common nitrogen-containing substances—nitroglycerine and gun cotton.

Ammonia and ammonium salts offer many other interesting and instructive experiments to the home chemist. The hydroxides of many metals, for example, can be formed by adding ammonia water (household ammonia will do) to solutions of the metals. Such solutions as copper sulphate, lead nitrate, iron chloride, iron sulphate, nickel sulphate, cobalt compounds, alum, and magnesim sulphate (Epsom salts) lend themselves well to this experiment.

The hydroxides form as curdy, jelly-like precipitates. In some cases they are so thick that the test tube in which they are made can be inverted without spilling the contents.

In these experiments, it is interesting to note that the precipitates of copper, nickel, and cadmium hydroxides will dissolve when more of the ammonium hydroxide is added to the solution. In the case of the copper sulphate, the resulting liquid will take on a deep azure blue color. If very strong ammonium hydroxide is used in the precipitating and dissolving processes, the blue solution will dissolve tiny bits of paper. This particular property has been used in the manufacture of artificial silk.

By adding water to a mixture of ammonium nitrate and zinc dust the experimenter can produce a small spontaneous flame. As the water is added, the mixture will bubble and smoke until it finally burns. Care must be taken, however, not to add too much water.

AS A safeguard, the mixture can be placed on the tin cap from a preserve jar and newspaper can be spread on the laboratory table to catch the chemicals should the mixture spatter.

No discussion of ammonia gas would be complete without some mention of its commercial uses. The most important uses of ammonia are as a refrigerating agent and for the preparation of ammonia water. Large quantities of ammonia, however, are also used in the manufacture of sodium carbonate, ammonium salts, and nitric acid.

SNOW EROSIONS STUDIED

SNOW erosion as a menace to wheat farms of the Northwest is being studied by experts of the U. S. Department of Agriculture. It has been found that where snowdrifts collect in the winter, soil is washed away by water from the melted snow when spring thaws set in. Because it is a common practice in the wheatlands to plow the ground in the fall, snowdrift erosion is particularly rapid there, the water easily carrying away the small particles at the top of the furrows. The north side of hills, where the snowdrifts are deepest, are most affected by the erosion. Methods of combating this type of soil thief are being worked out by the government investigators.

UNCLE SAM'S EXHIBITS AT WORLD'S FAIR

(Continued from page 11)

States outlined by lights that flare or fade under switch control. The leading countries with which Uncle Sam trades are designated by colored lights. Tiny miniatures of freighters and ocean greyhounds, moved by electric motors, pass along the established ocean lanes between this country and foreign ports.

Models of battleships, cruisers, and destroyers patrol the ocean, blockade strategic harbors, and go through the routine of war time precautions at sea. The animated spectacle, operating on a controlled time sequence, reproduces the activity of the Navy both in peace and war. For the first time in history, these stirring nautical maneuvers are fully reproduced in miniature.

Another naval exhibit emphasizes the changes in design and construction that have taken place during the 150-odd years that have elapsed since John Paul Jones fought in sailing ships. Six models of sailing ships cruise a tiny sea, side by side with half a dozen modern battleships. Seaplane and plane carrier models, a miniature *Akron*, cutaway models of the latest marine engines, the development in ship propulsion and improvements in propellers, naval weapons, bombs, projectiles, airplane appliances, and safety devices complete the display.

A REALISTIC model will illustrate the damage done by vast swarms of grasshoppers in a field of corn. An artificial grasshopper, thirty inches long, is mounted in the foreground and an illustrated text describes the insect's life cycle and tells how the pest can be controlled.

A full-scale reproduction of the interior of a modern ocean liner, equipped with the instruments and apparatus of the wheel room, offers a striking contrast to the model of the forecastle of a schooner of the type in use at the time of the Mexican War.

An exhibit by the Census Bureau of the Department of Commerce consists of a large statistical chart which signals the increases in our population that occur at twenty-second intervals during a selected day. In addition, lights flash on and off to record the fluctuations in births and deaths, and in emigration and immigration. A battery of tabulating equipment will show how the census data are handled, counted, sorted, and tabulated by machinery.

Puppet figures will re-enact the dramatic rescue work of the Bureau of Mines experts in mine disasters and demonstrate how first aid treatment is given to the injured.

Airports and the network of commercial airways will be shown on a large electric background map. A full-sized radio beacon will be operated by remote control, and nearby the teletype machine, now used by the Weather Bureau and Department of Commerce in sending out flying weather maps, will be in operation.

UNCLE SAM'S hundreds of exhibits will give a clear-cut idea of the far-flung activities of his scientists. There will be, for instance, a demonstration of finger printing as used in crime detection. A tiny reproduction of Old Faithful will show how a geyser works. In miniature, the visitor will see a modern live stock farm in successful operation. Models of coal and metal mines, of oil fields, of storage dams, and hydro-electric plants will supply a graphic picture of these giant industries.

Paintings and models will show transportation methods in Alaska, salmon fishing, and gold mining in the frozen North, the cabin of an Alaskan trapper, and the garments he makes from reindeer skin.

The accurate and world-wide methods of collecting and reporting crop conditions will be shown, along with the work of experts in solving problems for the dairymen of America. In an aquarium will be seen specimens of all our commercially valuable fish and the manner in which they are killed and packed.

A mysterious old Mayan temple in the Yucatan jungle has been recreated as headquarters of the national exhibit of the Indians. Models illustrate the tribal life and surroundings of the Indians of the woodlands as well as the buffalo-hunters of the plains. Wigwams, tepees of bark and skin, adobe homes of the Pueblo dwellers, the earth-covered hogans of the Navajos are all faithfully reproduced. Another display depicts the arts and crafts of civilized redmen, their success in the trades and agriculture and their present self-supporting ability.

The bill authorizing the participation of the federal Government in the Century of Progress exposition placed the work of creating and assembling the exhibits in charge of the Secretaries of Commerce, Agriculture, and State. Harry S. New, former postmaster-general, was appointed commissioner with Colonel W. B. Causey as assistant commissioner. Congress appropriated $1,000,000 to finance the national show. Approximately $200,000 was expended on the design and construction of the temporary Federal Building on the exhibition grounds while about $500,000 has been used in planning and building the exhibits that show what Uncle Sam does for the general public, and how he does it.

AMAZING SKILL WITH STRINGS GIVES LIFE TO MOST FAMOUS PUPPETS

(Continued from page 22)

is carried together with more than a ton of extra heads, legs, arms, cloth, and wire. Expert doll surgeons make rapid repairs upon injured actors while the company is on tour.

When the troupe of marionettes moves from one city to another, a hundred packing cases are required to hold the equipment, the little actors, and their specially-designed costumes. Each puppet is packed in its own cloth bag. Each wig and head goes in its individual container. And the costumes for the 800 members of the cast travel in large cases of special construction.

Vittorio Podrecca, the organizer of "The Theater of the Little Ones," began assembling this amazing company of puppets in 1916. Since then, he has taken his troupe of animated dolls around the world. During the present tour, they will visit the main cities of the United States.

TONS OF CANDLES TO LIGHT HOMES

SEVEN tons of candles a year, an English electrical engineer has computed, would be required to provide the same amount of illumination in the average small house that is now obtained from electric bulbs. With candles at ten cents a pound, he figures the average weekly bill for candlelight would be twenty-two dollars in winter and eight dollars and forty cents in summer! If candles were used to provide the same illumination now derived from electric equipment on subway trains, he reports, two tons of candles would have to be loaded on each train each morning.

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Gland Operations Effect Marvelous Cures

(Continued from page 36)

country, similar operations have since been performed with encouraging results.

Below the pancreas are the two adrenal glands, perched like a cocked hat, one on the upper pole of each kidney. Hardly bigger than large beans, they secrete one of the most powerful drugs known to man, adrenalin. One part adrenalin in 330,000,000 parts water can still be detected in the laboratory. Normally, the proportion of adrenalin in the blood is about one part in one billion. It is the fighting drug, released into the lifestream by emotions of anger and fear. It speeds up the heart and contracts the blood-vessels near the skin, thus increasing the supply to vital organs. In medicine, adrenalin is sometimes employed to stop hemorrhages and, under dramatic circumstances such as were described in an earlier article of this series, to bring back to life patients whose hearts have stopped on the operating table.

NOT long ago, three American scientists discovered adrenalin in the warts on the heads of five species of toads. Heretofore, the adrenalin used in hospitals was extracted from the glands of cattle, hundreds being required to produce enough for the people who needed it. It is predicted that special toad-farms may be established in the future for the production of this valuable drug.

When anything upsets the proper functioning of the adrenal glands in the human system, the body undergoes strange and startling changes. Women, for instance, grow beards and develop bass voices. One of the most remarkable operations I remember stopped a pair of runaway adrenal glands that were increasing the weight of a twenty-three-year-old girl 125 pounds a year.

She weighed 335 pounds when she came to Dr. Harry Koster, of Brooklyn, N. Y., in 1929. Her weight had almost tripled in the preceding years. He made an examination and discovered the cause was over-active adrenal glands. On the operating table, he made an incision through the thick muscles of the back and exposed the right kidney. The adrenal gland attached to it was three times its normal size. He removed it entirely and closed the wound.

The result was that the girl began to lose the abnormal fat as rapidly as it had developed. In the first month, without any dieting, she lost twenty-five pounds. During the rest of the year, she reduced at the rate of about fifteen pounds a month and in the end became normal size again. In addition, her health was greatly benefited.

BY SEVERING the nerve leading from the brain to the adrenals, Dr. George W. Crile, famous Cleveland, Ohio, surgeon, has recently been able to achieve astonishing results. Stomach and intestinal ulcers were cleared up, exophthalmic goiters were made to subside, and high-strung, nervous people were calmed down through this relatively-simple operation.

Few branches of surgery have made greater progress in recent years than that which deals with the pituitary, a gland about the size of the tip of your little finger which is locked in a bony box at the base of the brain near the center of the skull. It would seem to be the most difficult place in the world to reach with instruments. Yet, in emergencies, skillful surgeons, today, remove the gland entirely.

An inactive pituitary in childhood makes a dwarf; an over-active one produces a giant. When Magrath, the famous Irish giant, died, a post-mortem revealed that he had a pituitary gland as big as a hen's egg. Dinosaurs, a study of their skulls has indicated, possessed enormous pituitary glands. Sometimes, the pituitary alters the speed with which it manufactures the chemical it secretes into the blood with the result that people grow in spurts. The most remarkable instance of a pituitary suddenly speeding up its action is the case of Geoffrey Hudson, the English dwarf.

When he was eight years old he was a little more than twelve inches high. He remained about a foot and a half tall until he was thirty. At that age he was captured by Turkish pirates and the privations he suffered are thought to have affected the action of his pituitary gland. For, he suddenly began to grow, more than doubling his height. He attained three feet nine inches before the spurt stopped.

When the pituitary is affected during adult life, a rare disease known as acromegaly sometimes results. The hands and feet of the afflicted person begin to grow. Enormous gloves and shoes have to be made to order. At the same time the bones of the face enlarge, the cheekbones and forehead bulging and the lower jaw protruding. A delicate operation, reaching the pituitary, is necessary to halt the disease.

EVEN more delicate are operations upon the pineal gland, buried deep in the brain stem near the base of the skull. When a tumor forms upon this gland, bizarre symptoms result. The most striking is precocious sexual development. I recall one case in which a boy six years old was as fully developed as a seventeen-year-old youth as the result of such a pineal gland tumor. Unless the skill of the surgeon can remove such tumors, their pressure upon the internal fluids of the brain causes headache, blindness, and death.

The sex glands, both in men and women, secrete a hormone that is responsible for the traits of manhood and womanhood respectively. When the hormones formed by these glands are lacking, one is apt to become prematurely old. This is the fact behind various operations that have been performed in the hope of rejuvenating prematurely old people.

Most famous of all the surgeons who have performed such operations is Dr. Eugen Steinach, of Vienna, Austria. His technique consists in tying off the duct leading from the male gland, thus permitting the hormone-secreting parts of the gland to flourish and increase the amount of the chemical poured into the bloodstream.

Other surgeons, including the French scientist, Dr. Serge Voronoff, follow the practice of transplanting human or animal glands. Only last year a rejuvenation miracle was accomplished in a hospital in Belbeis, Egypt, by two Egyptian doctors. They transplanted a gland from a young man of twenty-five to an elderly man of ninety. A painful condition required that one of the younger man's glands be removed. The surgeons grafted it under the skin of the senile patient who was very weak and trembled constantly as aged people are quite likely to do.

THE graft took in a week's time and a most amazing change came over the old man. The wrinkles of his face were greatly diminished. The hair on his scalp became thicker. The trembling stopped. His appearance was so altered that friends failed to recognize him. Moreover, his mind became more alert and he felt more masculine in every way.

After a successful operation of this kind, the patient looks and feels younger. He enjoys life more. But such rejuvenation does not prolong life nor does it diminish the hardening of the arteries that accompanies old age.

Recently, Dr. H. Lyons Hunt, of New York City, has been relieving nervous and senile women, suffering from a deficiency of their sex glands, by grafting in glands obtained from freshly-slaughtered sheep.

An astonishing operation, which enabled a woman to become a mother after her sex glands had been removed, is on record in an eastern hospital. Because of extensive pelvic inflammation, it was necessary to remove the glands and their tubes. As both the woman and her husband earnestly desired a child, the surgeon, Dr. William Seaman Bainbridge, carefully examined the organs he had removed in the hope of finding a morsel of healthy gland.

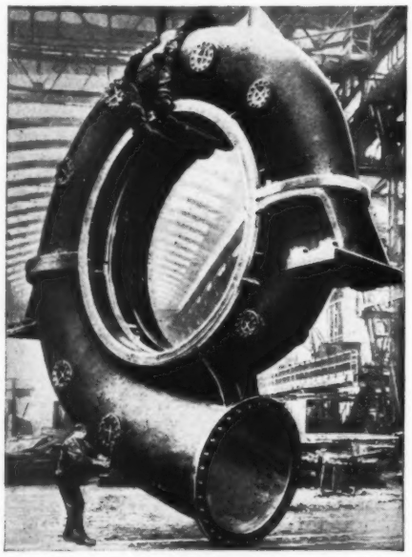
His search was rewarded. Discovering a piece hardly larger than the end of a little finger, he grafted it on the stump of one of the tubes. A year and a half later, the woman bore a healthy child.

Almost surpassing belief is another case reported by Dr. R. T. Morris, of the Post-Graduate Hospital, New York City. A woman whose sex glands had been removed bore a child through the agency of another woman's gland grafted inside her abdomen!

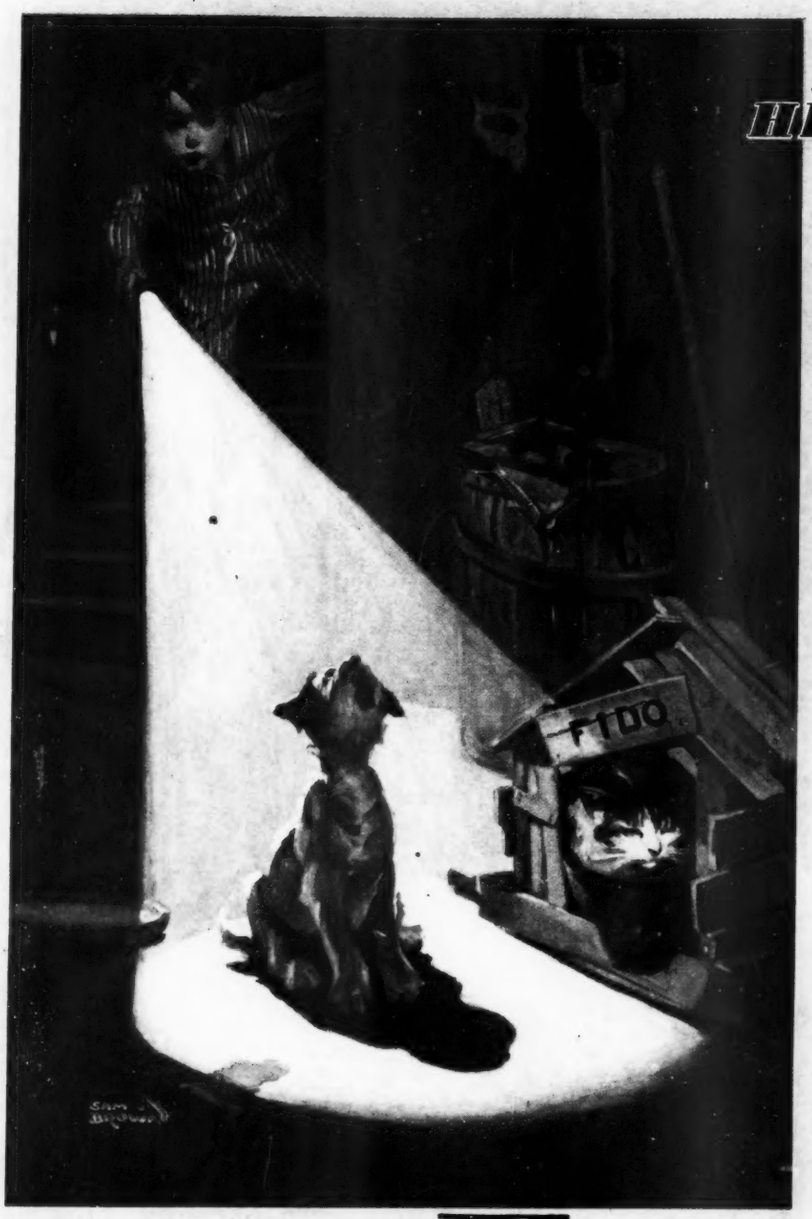
ON THE day when Dr. Morris operated upon her to remove the diseased organs, another surgeon at the Post-Graduate Hospital was operating upon another woman. A painful condition made it necessary to remove one of her glands and he offered it to Dr. Morris. The surgeon accepted it and at the end of his operation grafted a piece of this healthy gland, a little larger than a postage stamp, into the ligament which normally holds the female gland. Four and a half years later, the woman gave birth to a healthy girl baby weighing seven and a half pounds.

Such miracles of the operating room are growing more common each year. Researches are probing deeper into the mysteries of the human glands. Yet, in spite of the wonders already accomplished, surgeons know they are just beginning. No other branch of medicine offers more important or more dramatic possibilities for the future.

Giant Horn for Turbine



This piece of apparatus, looking like a horn upon which a giant might play, is really part of a water turbine for a hydroelectric plant. Water, rushing through it, spins the blades. It is 17 feet high and weighs 77,000 pounds



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